Investigating Human-Animal Interactions in Homes of Children with Autism Spectrum

Disorders: A Mixed Methods Approach

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Abstract

Through my doctoral program, I have developed a growing interest in looking at everyday experiences between people and animals, and how to examine human-animal relationships. My interest has transitioned to home-based exposure of animals, and how these natural experiences may look for individuals regularly interacting with their animals. Naturalistic interventions involve interactions between individuals and owned animals (i.e., pets), under ordinary circumstances, such as in the home. These naturalistic interventions are the focus of my research.

My first comprehensive exam involved a scoping review, looking at the impact of animals and children with ASD (Autism Spectrum Disorder) in the home environment. Studies show 1 in 54 children have ASD, which is a continually rising statistic (Maenner et al., 2020). Children with ASD experience difficulties obtaining adequate social skills, including things like social and emotional reciprocity, and social communication including verbal and nonverbal skills. Due to these differences in social skills, many children with ASD have difficulty bonding with loved ones, and behavior that can be challenging for parents. The purpose of this scoping review was to determine the state of the research regarding the effects of natural-based animal exposure for children with ASD.

Thirteen studies met criteria for the scoping review, which involved peer-reviewed studies with the primary focus on children with ASD and studied the impact of animals in the home. The research showed there were no consistent tools used to measure the human-animal relationship, and each study within this review utilized a different measurement tool. No study utilized valid or standardized measures to measure the human-animal bond for children with ASD. Many studies relied on parent report regarding the relationships between child and animal,

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and research has shown parent report may not be a reliable or accurate measure for child behaviors, and these surveys may not fully represent the nature of the relationship between child and animal. I recommended utilizing a standardized measure, such as the Observation of Human Animal Interaction for Research (OHAIRE). The OHAIRE coding tool is a timed interval behavior coding system that quantifies social communication and interactions with animals. The OHAIRE interactions include interactive behaviors (social communication and environmental interactions), emotional display (facial and verbal), and interfering behaviors (aggression, overactivity, and isolation).

Social skills and relationships emerged as the primary theme within this review and included two subthemes of safety and security and mental health implications. Regarding family characteristics, over half of the articles did not report on the severity of ASD within the study, however many the studies identified ASD severity as an important factor when considering animal ownership. Cost was associated with negative experiences for animal ownership in some of the studies, and it was recommended that financial obligations should be considered for families incorporating animals into their homes. Recommendations from my review included more rigorous research, identifying family characteristics that are best suited for animal ownership. These characteristics included child age, ASD severity, family income, and animal type. Recommendations also included utilizing an objective measurement tool to quantify the human-animal bond rather than relying on parent report.

My second comprehensive exam was a graduate research grant proposal submitted to the Organization for Autism Research and was written to fund my dissertation study. While I did not receive Organization for Autism Research funding, the proposal solidified my research plan for my third comprehensive exam and dissertation. Further, I submitted an edited version of this

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proposal to the KUMC Occupational Therapy Education department and received the Therapeutic Science Dissertation Research award, which funded my dissertation study.

My third comprehensive exam was a feasibility study utilizing the OHAIRE coding tool. The purpose of this study was to determine if the OHAIRE coding tool could be utilized in a home-based setting to code human-animal interactions in children with ASD. I also wanted to determine if inter-rater and intra-rater reliability could be reached between coders using data from the home-based videos.

The results included the submission of nine minutes of video. The video provided by participants was challenging to obtain, as only two out of five participants submitted video, despite ongoing communication efforts. Of the video provided, there were some coding challenges, as the quality of these videos differed from training videos provided from OHAIRE team. Despite challenges, the research team reached inter-rater and intra-rater reliability agreement between primary and secondary coders. Recommendations from this study included providing financial incentives to recruit more participants and training to parents for recording video to secure higher quality video in the home-based interactions. We found the OHAIRE coding tool to be a promising measure of in-home human-animal interactions and recommended further research include testing in home-based settings with larger and more diverse sample sizes.

My three comprehensive exams were foundational for my dissertation study. My dissertation expanded the use of the OHAIRE coding tool to measure human-animal interactions in the home environment. I wanted to examine the heterogeneity of interactions between children with ASD and their animals in their homes, and to explore the lived experiences of animal ownership in families of children with ASD. I found that there were meaningful differences with

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a large effect in overall interaction scores for children with moderate and severe ASD. There were smaller effects for those with mild and moderate ASD and a negligible effect between those with mild and severe ASD. Further, there were meaningful differences in interaction scores including talk, affection, and prosocial animal interaction scores by ASD severity. There were large effects for interaction scores for overall human-animal bond scores, as well as interaction scores including talk, gesture, look and touch between individuals with income \$60,001 - \$80,000 and those with \$80,001+.

Qualitative themes showed child development such as responsibility and communication, family considerations such as cost and training, and comfort and anxiety relief as important aspects of animal ownership. Describing child and family characteristics associated with favorable responses to having pets in the home can assist families to make informed decisions and professionals can provide informed guidance regarding animal ownership. Future research should involve clinical trials with larger sample sizes for generalization to the general population of children with ASD.

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Chapter 1: The Impact of Animal Exposure for Children with ASD: A Scoping Review

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Abstract

Animal-assisted interventions are increasingly used for children with ASD to promote inclusion and quality of life but are not accessible to many families. Companion animals may provide similar benefit but have not been well investigated within this population. This scoping review presents the state of research regarding natural-based animal exposure to children and adolescents with ASD. Thirteen studies met the criteria for inclusion within this review. The results found primary themes to include social skills and relationships; emerging subthemes included safety and security, and mental health benefits related to social skills. The research was primarily exploratory and qualitative with flawed methodology. Recommendations include continued research with longitudinal designs, more rigorous methodologies, and use of objective measures to study the human-animal bond.

Keywords: human-animal bond, autism, ASD, animals, natural intervention, animal exposure

Introduction

Humans and animals have been interacting for thousands of years, with the domestication of cats estimated to have begun 9,000 years ago and dogs beginning over 30,000 years ago (Driscoll et al., 2007; Wang et al., 2016). Currently, research estimates over 85 million United States households have animals (American Pet Products Association, 2019) and literature regarding how animals may help humans is growing. A study funded by the Human Animal Bond Research Institute (HABRI) found animal ownership was linked to a reduction in healthcare costs by up to \$11.37 billion dollars; this study reported 132.8 million pet owners were 60% less likely to visit a doctor for healthcare needs (Clower & Neaves, 2015). Further, this research found animal owners report lower stress, healthier weights, improved cardiovascular health, and reduced allergies when compared to those without animals.

Animals are increasingly being used as complementary therapy with vulnerable populations through animal-assisted intervention. These interventions include sessions with a trained animal handler and a team of individuals whom implement these interventions in community-based settings for a limited amount of time. A recent review of the literature indicates animal-assisted intervention can decrease agitation and aggression and increase quality of life and social interactions when introduced to individuals with dementia (Yakimicki, 2019). Further review of the literature showed animal-assisted interventions have been beneficial for individuals who have experienced trauma, particularly those diagnosed with posttraumatic stress disorder (PTSD), citing reduced depression, anxiety, and symptoms of PTSD (O'Haire, 2015). Animal-assisted interventions may also relieve pain and anxiety for children (Braun, 2009; Barker, 2015), improve cognitive function and mood of individuals with Alzheimer's (Menna, 2016), and be calming, socializing and motivating for individuals with attention-deficit /hyperactivity disorder (Busch, 2016).

Research shows 1 in 59 children are diagnosed with autism spectrum disorder (ASD) (Baio et al., 2018). Due to the increasing prevalence, there is a growing effort to understand the human-animal bond and its impact on families with children with ASD. A primary diagnostic criterion of ASD includes deficits in social skills including social-emotional reciprocity, response to social interaction, and social communication including verbal and nonverbal cues (American Psychological Association, 2013). Elliot and Gresham (1987) define social skills as behaviors that predict fundamental social outcomes for children, which can include peer acceptance, academic achievement, self-esteem, acceptable psychological adjustment, and teacher or parent judgement of key communicative social interactions. Due to these deficits in social skills, many children with ASD have difficulty bonding with loved ones, and often have episodes of elopement and irregular mood, and behavior that can be challenging for parents (United States Department of Health and Human Services, 2015).

Researchers began exploring the idea of animal-assisted interventions for children with ASD in the 1980's (Redefer & Goodman, 1989). Much of the current human-animal interaction literature encourages the use of animals as an intervention to assist with sensory challenges and increase social skills among children with ASD (Pavlides, 2008; Grandin et al., 2015). Many studies focus on animal-assisted interventions for improving specific outcomes over a select amount of time for children with ASD, and do not explore the effects of animal ownership. The purpose of this scoping review is to determine the state of the research regarding the effects of natural-based, versus intervention-based, animal exposure to children and adolescents with ASD.

Methods

The research team conducted a scoping review using Arksey and O'Malley's (2005) methodological recommendation for scoping review search strategies. A scoping review was necessary due to the broad range of research activities, multidisciplinary nature of the work, and the complexities of the human-animal bond. The first stage of Arksey and O'Malley's framework includes developing a research question. This scoping review aimed to examine the following question: *What is the state of the research regarding natural-based animal exposure to children and adolescents with ASD?* The next methodological steps follow the Arksey and O'Malley (2005) framework for scoping reviews:

Identifying Relevant Studies

An experienced medical librarian drafted the search strategies and reviewed with the primary authors. The librarian conducted a comprehensive online literature search in four databases during the period 2-7-19 to 2-22-19. The databases included OVID Medline, CINAHL, PsychINFO, and Proquest Nursing and Allied Health. A combination of keywords and controlled relevant vocabularies, when available in the databases, were used to conduct the searches. Search techniques such as adjacency search and truncating were used to increase sensitivity of results (see Table 1). The medical librarian exported search results and removed duplicates using the bibliographic management software EndNote. The researchers also completed a search of ClinicalTrials.gov, Google Scholar, and pertinent professional organization websites to locate literature.

Study Selection

For inclusion in the review, articles were 1) peer reviewed research articles, 2) written in English, with 3) primary focus on children and adolescents with ASD, and 4) studied the impact of animals in the home. Due to limited research, the search had no date range constraints and

articles using any research method (qualitative, quantitative, and mixed-methods) were included. Exclusion criteria included, 1) focus on a short-term intervention, 2) the animals were not living in the home, and 3) the focus was outside the child impact (i.e., parent outcomes, testing measurement tools).

Chart Data

The scoping review guidelines encourage a multi-stage process of charting the data from the literature search. The primary author developed descriptive characteristics of the articles including study design, sample size, gender, age, diagnosis, levels of measurement, identified theme(s), and study outcomes. Study details and key findings can be found in Table 2.

Summation, Collation, and Synthesis

Researchers reviewed the articles to understand the state of the research, and then studied the articles to identify concepts based on study outcomes. The primary author grouped and translated themes from the study outcomes, with social skills emerging as a dominant theme, and safety and security, and mental health implications emerging as subthemes related to social skills. The primary author confirmed theme selection with the secondary author and found no disagreements within this process. The primary author defined the themes based on relevant research within the ASD literature. Study details with identified themes are included in Table 2.

Results

Overview of Results

The initial search yielded 1295 articles. Researchers removed 997, as these articles were duplicates within the databases. The research team reviewed titles and abstracts of 298 articles and a significant portion were excluded as intervention-based studies. This refers to animals that were introduced to children over a select amount of time to provide a particular outcome in

behavior. Other articles were excluded based on 1) animal testing and response studies, 2) dissertations, 3) book chapters, 4) expert opinion, 5) review articles, 6) focus on family outcomes, and 7) focus on measurement development. Within the review articles, the primary author identified potential studies through the reference lists to ensure all potential studies had been located within the search. The primary author identified five articles that could not be clearly included or excluded and consulted the second author to determine appropriateness for the study. Four of the articles had the primary focus on family outcomes and one study had some relevance, but the primary focus was on creating a new measurement. Both researchers determined all five studies to be ineligible for inclusion. After exclusions, 13 articles fit the criteria to be included in this scoping review (see Figure 1).

The search located articles dating from 2008 to 2018. Nine out of 13 studies were published in the last five years, suggesting this area of study has recent relevance. Sample sizes of the studies ranged from 7 to 338 individuals, with most studies (n=11) having a sample size of 75 or fewer participants. Eight studies exclusively studied dogs (Burrows, Adams, & Spiers, 2008; Burgoyne et al., 2014; Smyth & Sleven, 2010; Wright et al., 2016; Viau et al., 2010; Wright et al., 2015; Carlisle, G., 2014; Harwood, Kaczmarek, Drake, 2018), four studies examined any identified companion animal (Carlisle et al., 2018; Bystrom, & Lundqvist Persson, 2015; Ward, Arola, Bohnert, & Lieb, 2017; Grandgeorge et al., 2012), and one study exclusively studied cats (Hart et al., 2018). No study reflected time of animal ownership. There was a large international representation within the articles, with eight of the thirteen studies conducted outside of the United States. Countries of representation included Ireland (2 studies), Canada (2 studies), Sweden, United Kingdom, Australia, and France (1 study each).

Six articles were quantitative in design, and two mixed methods. Five studies utilized a control group design. Two of the control group designs compared animal ownership to those on a wait list to be assigned a service dog (Wright et al., 2015; Burgoyne et al., 2014). One article utilized a pre-post design, and measured cortisol levels prior to animals living with the children, during, and 2 weeks after the animal was removed (Viau et al., 2010). Only two studies collected data at follow-up time points, one at two weeks (Viau et al., 2010) and one longitudinal study that followed participants for one-year, interviewing families every three months (Burrows, Adams, & Spiers, 2008). Five of the articles were qualitative in design, and included phenomenological (n=2), focus groups (n=1), multiple case studies (n=1), and ethology (n=1) methodology.

None of the studies identified race or ethnicity among participants. Two of the articles did not provide information on the gender of the children being studied and instead provided demographic information on the parents being interviewed (Carlisle et al., 2018; Hart et al., 2018). Of the studies that provided information on gender, there were a total of 483 boys within the studies, and 71 girls. Table 3 highlights these article characteristics.

Four of the studies included specific information about utilizing DSM IV criteria for a diagnosis of ASD (Grandgeorge et al., 2012; Carlisle, 2014; Ward et al., 2017; Wright et al., 2015). One study conducted in Ireland utilized the Irish Health Services Executive, which utilizes the Autism Diagnostic Interview and the Diagnostic Interview for Social Communication (Burgoyne et al., 2014). Five articles reported a formal diagnosis of ASD, however did not include the DSM IV standards as part of the qualification process. Three articles did not include specific criteria about the participant diagnosis, however referred to the participants as "ASD" or "autistic" (Hart et al., 2018; Burrows et al., 2008; Smyth & Sleven, 2010).

Measurement Implications

The research showed there were no consistent tools used to measure the human-animal relationship, and each study utilized a different measurement tool. Most studies (n=9) asked questions determined by researchers and no study utilized valid or standardized measures to measure the human-animal bond within children with ASD. Other measures used within the studies included Social Skills Improvement System Rating Scale (SSiS-RS), and Companion Animal Bonding Scale (CABS) (Carlisle, 2014); Youth Self Report-Depression Scale, Loneliness Scale, Loneliness Scale-Parent, and Friendship Quality Questionnaire Parent (Ward et al., 2017); Perceived Competence Scale, Caregiver Strain Questionnaire, and adapted Neighborhood Environment and Walkability Scale (Burgoyne et al., 2014); Brief Version of the Family Assessment Measure -III, and Spence Children's Anxiety Scale (Wright et al., 2015).

One study (Carlisle, 2014) identified the Companion Animal Bonding Scale, which is an eight question Likert scale that aims to identify ways the respondent interacts with their animal; the scale includes items such as cleaning up, traveling with, holding or petting, sleeping near, and responsible for care of the animal (Poresky et al., 1987). This study asked the children with ASD to complete this survey, however this tool has not been validated with the ASD population. Further, children with ASD are typically not the primary care taker of the animals in the home, as this responsibility falls to the parents; therefore, validity of these tools needs to be considered within this population.

Many of the studies did not provide the questions asked by researchers, however one study asked the question, "Do your children benefit from companion animals, and what have your experiences been" (Bystrom & Persson, 2015, p. 266). This question may lead parents to only discuss benefits of animal ownership, leaving potential problems associated with animals

unexplored. A standardized measure of the human-animal relationship is critical to implement research investigating causality or correlational evidence of animals living with families of children with ASD.

Key Findings of Human-Animal Bond

Social skills and relationships emerged as the primary theme and included two subthemes of safety and security and mental health implications. Social skills refer to the behaviors that can increase or predict healthy social normative outcomes, such as communication, peer acceptance, etc. (Elliot & Gresham, 1987). Using this framework, the authors determined which articles provided outcomes based on social skill attainment and relationship growth. For the purposes of this study, safety and security can be defined as the protection and care of the individual with ASD, including assisting in the prevention of elopement behavior. Mental health implications refer to the study outcomes that reduce mental health symptoms such as anxiety, depression, obsessive compulsive disorder, and post-traumatic stress disorder.

Twelve of the thirteen articles included social skills and relationships as an outcome measure, nine as the primary outcome. The study that did not include this outcome was measuring cortisol levels and did not study other possible social results. All but one study relied on parent report of the relationships between child and animal and included researcher observation of the human-animal interaction. Nine of the articles involved untrained animals, and three involved trained animals. For the purposes of this study, untrained animals refer to pets within the home that have not had professional training for the benefit of the child or family. Trained animals include animals that were either service or therapy animals, skilled at providing the child with behavioral and emotional support. There did not appear to be outcome differences between trained and untrained animals within these studies, however animal temperament was

considered important to tolerate erratic and sometimes harsh behaviors that can occur within the ASD population (Burgoyne et al., 2014; Smyth & Slevin, 2010).

All twelve studies outlined the love and companionship children gained from having an animal in the home; several studies highlighted the enhancement of joy and communication associated with being in the presence of the animal. One cross-sectional study utilized the Family Assessment Measure Version III to determine family functioning, and found relationships were significantly improved within the group of animal-owners, vs the group of non-owners (Wright et al., 2015). Further studies also showed enhancement of family dynamics, encouragement of activities, and provided a way for the child to be included within the family (Wright et al., 2016). Another quantitative study surveyed high-functioning children with ASD and showed the child was more likely to feel companionship from the animal if the child had responsibilities associated with caring for the animal (Ward, Arola, Bohnert, & Lieb, 2017). Though most studies showed benefit, one study (Carlisle, 2014) found no significant differences in children's total social skills scores between dog owners and non-dog owners within the Social Skills Improvement System Rating Scale (SSiS-RS). This study did find a significant difference in the levels of the subscale item assertion within the SSiS-RS.

Qualitative evidence showed comparable findings. Carlisle et al. (2018) asked caregivers to describe their relationships with animals through write-in interviews. Of the 338 caregivers interviewed, researchers found that the primary benefit of living with the animal was the companionship from the non-judgmental relationship. One study indicated the child would have long conversations with the animal, which the authors determined to be encouraging socialization skills and could assist with communication barriers for the children (Byström & Lundqvist Persson, 2015). Further, Smyth & Slevin (2010) found that the animal acts as a

catalyst for social interactions in public, encouraging community integration and discouraging isolation which can be common in families with a child with unpredictable behavior. Qualitative methodology varied in rigor, with lack of transparency of questions and analysis in some studies.

Safety and security

Safety and security emerged as a subtheme within social skills. Two qualitative research studies and one mixed methods study investigated experiences of families with a child with ASD and revealed the importance of safety and security when animals are in the home (Burgoyne et al., 2014; Smyth & Slevin, 2010; Burrows, Adams, & Spiers, 2008). One of the three articles reported safety and security as the primary theme that emerged from the data (Burrows, Adams, & Spiers, 2008). This study found that the service dog allowed parents to remove locks and alarms on doors, which were previously in place to provide safety and prevent the child from wandering. Further, the animal would sleep with the children at night and wake the parents if the child was upset or if anything went awry, which helped the family feel less worry. This study was the only study to utilize researcher observation of the human-animal interaction within the home and community.

Two of the studies addressed child elopement. Smyth and Slevin (2010) interviewed seven parents and found that the animal prevented the child from running into traffic or eloping to a dangerous scenario. Parents reported that the dog would continually track the child and bark or pace to alert parents if something was wrong. This presence of the animal provided security in public and made social outings more manageable for parents and the child. Further, researchers compared the perceived safety of individuals with a service dog, and those on the waitlist for a service dog by using a questionnaire that measured environmental hazards, perceived

competence, and caregiver strain (Burgoyne et al., 2014). Results showed those with a service animal had significantly higher perceived safety than those without.

Mental health

Mental health benefits also emerged as a subtheme of social skills in this review. Six studies showed mental health implications for children with ASD (Wright et al., 2015; Ward, Arola, Bohnert, & Lieb, 2017; Byström, & Lundqvist Persson, 2015; Viau et al., 2010; Wright et al., 2016; Smyth & Slevin, 2010). Three studies reported the animal eased depressive symptoms and encouraged joy and resiliency within the child (Byström, & Lundqvist Persson, 2015; Smyth & Slevin, 2010; Ward, Arola, Bohnert, & Lieb, 2017). The majority of the studies (n=5) found that the companion animal offered comfort and a mode for coping in times of stress and anxiety.

Wright et al. (2015) utilized the Spence Children's Anxiety Scale and showed lower anxiety scores including obsessive compulsive disorder, panic attack and agoraphobia, social phobia, and separation anxiety in the dog-owning group, compared to the non-dog owning group. Viau et al. (2010) showed a 48% decrease in cortisol levels in children with a service dog in the home. A qualitative study of seven individuals by Smyth and Slevin (2010) found parents reported the children show less anxiety, fewer tantrums, improved coping skills, and stated their child's depression was "relieved" when with their animal (p. 16).

Practical Application

It is important to understand how these results may be applied in the daily lives of families and children with ASD. Three studies reported the increase in responsibilities of caring for the animals were difficult (Smyth & Slevin, 2010; Carlisle et al., 2018; Burgoyne et al., 2014), however each study reported the benefits of the animal outweighed the challenges. Seven articles did not report on the severity of ASD within the study. The remaining articles sampled

high functioning children with ASD (Carlisle, 2014; Ward et al., 2017), or separated individuals considered as high functioning and lower functioning within the study (Hart et al., 2018; Wright et al., 2015; Burgoyne et al., 2014; Wright et al., 2016). Ward et al. (2017) showed the higher the child's IQ, the more likely the child would take responsibility in caring for the animal, and also the more likely the child would seek companionship from the animal; this study also found age was significantly positively associated with responsibility. Hart et al. (2018) found that children with less severe ASD had higher rates of affection towards animals. These results suggest the older the child, less severe the ASD, and the higher the IQ will lead to more responsibility and greater positive relationships with the animal.

Two studies reported family income, with one study reporting mean income to be \$69,500 (Viau et al., 2010) and the other reporting 44.3% of the sample had income \$81,000+, and 32.9% ranged from \$41,000-\$80,000 (Carlisle et al., 2018). These studies do not report family size and composition, consequently this data does not assist with understanding income needs for pet ownership. Cost was associated with negative experiences for animal ownership in three of the studies (Burgoyne et al., 2014; Wright et al., 2016; Carlisle et al., 2018), stating the financial burden animal ownership can have on a family; therefore, financial obligations should be considered for families incorporating animals into their homes.

Discussion

This scoping review utilized broad and rigorous search strategies to locate the most relevant research. The search revealed only 13 articles that met the inclusion criteria, which shows there is limited research related to natural human-animal interactions among families of children with ASD. Exploratory methods have been necessary due to the lack of research within this topic area and can be helpful for identifying potential outcomes and guiding future research.

Overall, the findings of this scoping review indicate there are positive aspects of the human-animal bond in the natural setting, namely social and relational benefits. These benefits included providing love and companionship, encouraging communication and social interaction, and improving the bonds within family relationships. Because symptoms of ASD include deficits in social skills including communication, social interaction and social-emotional reciprocity (American Psychological Association, 2013), children and families experiencing these deficits may directly benefit from the human-animal bond.

Attempts to provide animal-assisted interventions within the ASD population have become increasingly common. Animal-assisted interventions utilizing a trained provider and trained animal, can require 400 hours of training (American Kennel Club, 2019) and can be costly for families. Exposure to animals in the home may be more accessible and provide similar benefits for families. Additionally, having an animal in the home may provide more sustainable effects through continued animal-interaction since it does not require extensive training or travel to a therapist. Guidelines established by Health Resources and Services Administration (HRSA) Autism Intervention Research suggest children with ASD should have access to at least 25 hours per week of non-medical interventions to encourage social skill attainment (Maglione et al., 2012). In a review of the literature, Cowan & Allen (2007) suggest naturalistic interventions can be a preferred method because of increased duration and frequency of interactions, which increase the overall effectiveness of the relationship for children with ASD. For example, recessbased activities have shown to increase social initiations and taking turns through peer-mediated practices (Harper, Symon, & Frea, 2008). Because structured interventions are costly and require skilled providers, child-animal interactions in natural settings may provide social skill attainment and be more accessible for families faced with these barriers to care.

The findings also indicated safety as a benefit within the ASD population. Anderson et al. (2012) surveyed over 1,200 families and found that 49% of the children with ASD had attempted elopement at least once. Further, 26% of those that eloped were found to be at risk of serious injury or death. Two of the studies within this review addressed child elopement, with parents reporting individuals with an animal had significantly higher perceived safety. However, because there were no objective measures within either study, it cannot be known whether the children were actually safer, or if the perception of having an animal provided unrealistic levels of safety and security. As with any study utilizing proxy report, there can be overestimation and idealistic reporting of results (Kesten et al., 2015; Engel, Rodrigue & Geffken, 1994). With the elopement risk and its potential harm within this population, further research is needed to confirm if animals provide safety for children ASD.

This scoping review identified animals as benefitting mental health of individuals with ASD. Co-occurring conditions persistent with ASD include social anxiety disorder, attention-deficit/hyperactivity disorder, generalized anxiety disorders, major depressive disorders, and oppositional defiant disorder (Simonff et al., 2008; Skokauskas & Gallagher, 2012; Mattila et al., 2010). These studies found a prevalence rate of 74% for one or more co-occurring psychiatric disorders within the ASD population. This scoping review showed interactions with companion animals can relieve stress and anxiety, ease depression symptoms, and lessen tantrums. These claims are based on primarily parent report and qualitative methodologies, which increase understanding of benefits of animal interactions but may not be generalizable. More rigorous human-animal bond research is needed to determine causal effects for children with ASD and symptoms of mental health.

Implications for Research

The available literature on the human-animal bond of children with ASD and their families is limited. This review revealed few studies, which were primarily exploratory and qualitative, and cannot be generalized. Future research should employ more rigorous methodologies and consider comparison studies to provide evidence of the positive and negative aspects of animal ownership. Six studies in this review reported the severity of ASD as a consideration for the quality of the human-animal bond, however only one study made implications from these differences for practical application in the field. Future research should identify child and family characteristics such as age, income and ASD severity that will best respond to human-animal interactions. Further, the available literature in this review included only one longitudinal study which followed participants for one year. This indicates a need for future studies that examine the relationship between children with ASD and their animals' long term.

Due to the current state of the research that is limited in its ability to provide objective standardized measures of the human-animal bond, the Observation of Human-Animal Interaction for Research (OHAIRE) is a promising tool created by researchers to evaluate human-animal interactions and code behavior in natural settings (Guerin et al., 2018). The OHAIRE is a timed interval behavior coding system which quantifies social communication and interactive behaviors between humans and animals. This tool is the first measurement tool available for research that could be helpful in quantitatively evaluating interactions to determine the effect of the human-animal bond. The OHAIRE measurement tool has potential to expand current understanding of human-animal bond beyond parent report by providing reliable, objective observation data.

Conclusion

The majority of studies included in this scoping review found that animals can improve the social skills of children with ASD. However, the lack of objective measurement and the relatively small number of controlled trials make it difficult to recommend animal ownership to families with children with ASD. The available research suggests study of human-animal bond in natural settings is exploratory and preliminary in nature, which has set the groundwork for comparison and longitudinal studies. Having animals in the home has promising benefits for families of children with ASD, including social, safety, and mental health benefits. Further investigation with rigorous methods is necessary to confirm and promote implementation of these results. Future research should include studies with large, diverse sample sizes that focus on quantitatively identifying the relationship between children with ASD and their animals.

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Figure 1. Flowchart of Article Selection Process. Adapted from PRISMA Extension for Scoping Reviews, 2018

Table 1.

OVID Medline Search Strategy

#	Searches
1	exp Autism Spectrum Disorder/
2	(autism\$ or autistic\$).kf,tw,mp.
3	exp Animal Assisted Therapy/
4	1 or 2
5	3 and 4
6	bonding, human-pet/
7	((human adj3 (pet or pets)) and (bond or bonding or attach\$)).tw, kw,mp.
8	6 or 7
9	8 and 4
10	animals, domestic/ or pets/ or animals/
11	(animal or pet or pets or dog or dogs or cat or cats or canin\$).mp.
12	10 or 11
13	(own\$ or bond\$ or relation\$ or attach\$ or love or loving or emotion\$)
14	13 and 12 and 4
15	Famil\$ or Parent\$ or Home\$ or Domestic\$
16	15 and 12 and 4
17	"Pet ownership".kw,tw.
18	19 and 4
19	5 or 10 or 15 or 20
Table 2.

Study Details

Author/ Sample Design Date		Design	Measurement	Theme(s)	Results			
Grandgeo12; 8Quantitative;Unstandrge et al.,control groupquestion2012design;Rquasiexperiemental		Unstandardized questions; ADI- R	Social Skills & Relationships	Increase in some prosocial behaviors (sharing, offering comfort)				
Carlisle, 2014	70; children over 8 years old	Quantitative; cross- sectional	Social Skills Improvement System Rating Scale (SSiS- RS); Companion Animal Bonding Scale (CABS)	Social Skills & Relationships	No significant difference in overall social skills between dog owning, and non-dog owning families. Significantly higher "assertion" skills for pet owning children. Children significantly more attached to smaller dogs than larger.			
Wright et al., 2016	40 parents; 20 dog owners, 20 non dog owners	Quantitative; control group design; quasiexperim ental	Unstandardized 24 item interview, coded into themes	Social Skills & Relationships ; Mental Health Implications	Family unification, companion/friendshi p from animal relationship, animal provides confidence, increase in children's activities, improvements in motor skills & stamina			
Viau et al., 2010	42 children	Quantitative; pre-post	Measured cortisol levels	Mental Health Implications	48% decrease in cortisol levels with service dog; Improved sleep via parent report, decrease of problematic behavior			
Ward et al., 2017	73 high function ing adolesce	Quantitative; cross- sectional	Pet ownership questionnaire, developed by researchers;	Mental Health Implications; Social Skills	Children who took more responsibility for their pet had fewer depressive			

	nts with ASD; 152 parents		Youth Self Report- Depression Scale, Loneliness Scale, Loneliness Scale-Parent, Friendship Quality Questionnaire	& Relationships	symptoms; better friendship quality, assist with social- emotional development
Burgoyne et al., 2014	134 parents/ guardian s with assistanc e dog; 87 guardian s on waiting list	Mixed; control group design	Parent Perceived Competence Scale, Caregiver Strain Questionnaire, adapted Neighborhood Environment & walkability Scale determined by researchers	Safety & Security; Social Skills & Relationships	Parents with assistance dog rate their child significantly safer from environmental dangers, and that the public respond more respectfully & responsibly toward child. Parents that have assistance dog rate themselves as more competent about managing their child
Wright, et al., 2015	42 intervent ion group, 28 control group	Quantitative; control group design	Brief Version of the Family Assessment Measure -III, Spence Children's Anxiety Scale	Mental Health Implications; Social Skills & Relationships	Dog owning groups showed improvements in family functioning, decrease in anxiety scores including OCD, panic attack and agoraphobia, social phobia, and separation anxiety.
Smyth & Slevin, 2010	7 families	Qualitative; phenomenolo gical	Unstandardized/ qualitative questions determined by researchers; no coding/data analysis reported	Mental Health Implications; Safety & Security; Social Skills & Relationships	Improved sleep, less anxiety, increased safety, family cohesion, increased self-esteem, no tantrums, improved coping skills, depression "relieved."

Burrows et al., 2008	10 families	Qualitative; ethology	Video recording of family-dog interactions, unstructured interviews	Safety & security; Social skills & relationships	Increased safety, gaining freedom as a family, improvement of social status, assisting with daily tasks and making them easier, animal assists with sensory needs
Carlisle et al., 2018	338 parents	Qualitative; phenomenolo gical	Unstandardized survey/ interview	Social skills and relationships	Companionship, increase in physical activity, learning opportunities for social/communicatio n skills, increased feelings of safety; concerns included handling grief, cost, and ensuring a good animal/child fit
Harwood et al., 2018	13 children with ASD, 11 mothers of children	Qualitative; multiple case study	Unstandardized phone interview, questions determined by researchers	Social skills and relationships	Love and companionship, perception of ownership, comfort and calming influence, canine's ability to assist the child with understanding their world, and challenging experiences
Bystrom, K, Persson, C., 2015	12 families	Qualitative; focus group discussions	Unstandardized questions, focus group discussion	Social skills & relationships; mental health implications	Social and behavioral development, improved mental health, increased interaction with others, quality relationship with the child
Hart et al., 2018	64 web survey; 48 families	Mixed; multiple case study; control group design	Unstandardized web survey designed by authors; interviews	Social Skills & Relationships	Companionship with cats, comfort, uncommon interaction such as reading and talking.

intervie wed	Children with less severe ASD had
	higher rates of affection toward cats

ASD: Autism Spectrum Disorder OCD: Obsessive Compulsive Disorder ADI-R: Autism Diagnostic Interview-Revised

Table 3.

Sample Characteristics

Author/Date	Age	Gender	Income
Grandgeorge et al., 2012	6 to 34	59 boys; 19 girls	not available
Carlisle, 2014	Mean age 13	65 boys, 5 girls	not available
Wright et al., 2016	3 to 15	30 boys; ten girls	not available
Viau et al., 2010	3 to 14 years old	37 boys; 5 girls	ranged from 12,000 to 150,000; mean \$69,500
Ward et al., 2017	Mean age 13.91	87.5% male	not available
Burgoyne et al., 2014	0 to 9	70 boys with dog; 77 boys without	not available
Wright, et al., 2015	2 to 16	8 girls; 34 boys intervention; 7 girls; 21 boyscontrol	not available
Smyth & Sleven, 2010	5 to 12	6 boys; 1 girl	not available
Burrows et al., 2008	4.5 to 14	7 boys; 3 girls	not available
Carlisle et al., 2018	No information on children	No information on children	44.3% \$81,000+; 32.9% \$41,000- \$80,000; 8.1% \$21,000-\$30,000
Harwood et al., 2018	5 to 12	7 boys; 6 girls	not available
Bystrom, K, Persson, C., 2015	8 to 20	6 boys; 6 girls	not available
Hart et al., 2018	5 to 12	not available	not available

Chapter 2: Organization for Autism Research Graduate Research Grant Application—

Coding Human-Animal Interactions in Children with ASD:

Use of the OHAIRE coding tool for human-animal interactions in children with ASD in

community settings

Abstract

Animal-assisted interventions are increasingly used for children with autism spectrum disorders (ASD) to promote socialization, inclusion, and quality of life. However, these interventions may not be accessible to many families. Companion animals may provide similar benefit but have not been well-investigated within this population. Research in naturally-occuring animal exposure for children and adolescents with ASD is vital to understanding the growing interest in the human-animal bond.

The proposed project is a mixed methods study utilizing The Observation of Human-Animal Interaction for Research (OHAIRE) to measure human-animal interactions between children with ASD and their animals in the home. The OHAIRE tool codes behavior to evaluate humananimal interactions in natural settings (Guerin et al., 2018). The OHAIRE measures emotional displays, communication, social behaviors, and problematic behaviors within human-animal interactions. The OHAIRE has been used to investigate human-animal interactions with children with ASD in structured settings (classrooms, hospitals, etc.), but not within home settings. Caregiver interviews will provide contextual data to understand the experiences families have with their animals. The goal of this project is to fully examine the natural interactions children with ASD have with their animals. Results of this study will provide essential evidence of natural, human-animal interactions and inform the autism community of the practical implications of animal exposure for children with ASD.

Background

Humans and animals have been interacting for thousands of years, with the domestication of cats estimated to have begun 9,000 years ago and dogs beginning over 30,000 years ago (Driscoll et al., 2007; Wang et al., 2016). Currently, research estimates over 85 million United

States households have animals (American Pet Products Association, 2019) and literature regarding how animals may help humans is growing. In a study funded by the Human Animal Bond Research Institute, researchers found animal ownership can be linked to reducing healthcare costs by up to \$11.37 billion dollars, reporting 132.8 million pet owners were 60% less likely to visit a doctor for healthcare needs (Clower & Neaves, 2015). This same research found animal owners report lower stress, healthier weights, improved cardiovascular health, and reduced allergies when compared to those without animals.

Animals are increasingly being used as complementary therapy for vulnerable populations through animal-assisted intervention. These interventions include sessions with a trained animal handler and a team of individuals who implement these interventions in community-based settings for a limited amount of time. A recent review of the literature indicates animal-assisted intervention can decrease agitation and aggression and increase quality of life and social interactions when introduced to individuals with dementia (Yakimicki, 2019). Further review of the literature showed animal-assisted interventions have been beneficial for individuals who have experienced trauma, particularly those diagnosed with posttraumatic stress disorder, citing reduced depression, anxiety, and symptoms of PTSD (O'Haire, 2015). Animalassisted interventions may also relieve pain and anxiety for children (Braun, 2009; Barker, 2015), improve cognitive function and mood of individuals with Alzheimer's (Menna, 2016), and be calming, socializing and motivating for individuals with attention-deficit /hyperactivity disorder (Busch, 2016). Research has consistently shown animal-assisted therapies can be beneficial for mental and physical needs within vulnerable populations.

Research shows 1 in 59 children are diagnosed with autism spectrum disorder (ASD) (Baio et al., 2018). Due to the prevalence of autism and interest in animals as complementary

therapy, there is a growing effort to understand the human-animal bond and the impact on families with children with ASD. Primary diagnostic criteria of ASD include deficits in social skills including social-emotional reciprocity, response to social interaction, and social communication including verbal and nonverbal cues (American Psychiatric Association, 2013). Due to these deficits in social skills, many children with ASD have difficulty bonding with loved ones and can have episodes of elopement and irregular mood, and behavior that can be challenging for parents (United States Department of Health and Human Services, 2015).

Researchers began exploring the idea of animal-assisted interventions in children with ASD in the 1980's (Redefer & Goodman, 1989). Animal-assisted interventions involve animals, often highly trained, introduced to children over a select amount of time to provide a particular outcome in behavior. Much of the current human-animal interaction research encourages the use of animals as an intervention to assist with sensory challenges and increase social skills among children with ASD (Pavlides, 2008; Grandin et al., 2015). Many studies focus on animal-assisted interventions for improving specific outcomes for children with ASD, and do not explore the effects of animal ownership.

Natural-based animal exposure involves interactions between individuals and owned animals, under ordinary circumstances. In a recent scoping review of natural-based animal exposure for children with ASD, there were only thirteen articles available and met criteria for inclusion (Lisk & Mische Lawson, 2019, under review). This review showed there were no consistent tools used to measure the human-animal relationship, and each study utilized a different measurement tool. Further, the relatively small number of controlled trials make evidenced-based recommendations for animal ownership difficult. The available research suggests study of human-animal bond in natural settings is exploratory and preliminary in nature,

which includes significant gaps including lack of objective observations of interactions in home environments, where children and animals interact, and lack of information about the downsides of animal ownership. It is critical that future studies explore these literature gaps to lay the groundwork for comparison and longitudinal studies.

Researchers recently developed the OHAIRE coding tool and have published four studies with a total of 201 children (ages 5-18), with and without ASD (Guerin et al., 2018). These researchers have found good inter-rater and intra-rater reliability of the OHAIRE tool with children with ASD in settings such as schools, group therapy programs, therapeutic horseback riding programs, and hospital settings. The OHAIRE tool was also found to have correlation between social behaviors and emotional displays, and social skills from the Social Skills Rating System (SSRS) and Social Communication Questionnaires (SCQ). The proposed study will expand use of the OHAIRE coding tool to measure human-animal interactions in the home environment.

Specific Aim 1. To examine the ways children with ASD interact with animals in their homes.Specific Aim 2. To explore the lived experiences of animal ownership in families of children with ASD.

Hypotheses. We will use a mixed methods design to explore the experiences and natural interactions children with ASD have with their animals in their homes. We hypothesize that children with autism will have positive interactions with their animals. We also hypothesize children's Social Responsiveness Scale scores (SRS; Constantino & Gruber, 2005) will negatively correlate with scores on the social interactions subscale within the OHAIRE coding tool, indicating children with less social challenges will have greater natural social interactions with their animals. Our qualitative methods involve an emergent design from a naturalistic

inquiry of research (Sandelowski, 2000), which includes gathering data without guidance by *a priori* hypotheses.

Preliminary Findings

Our research team is currently investigating the use of the OHAIRE coding tool in natural settings with families of children with ASD. The goal of this study is to determine the barriers to using the OHAIRE coding tool in families' homes. We expect the study will refine procedures for recording and sending child-animal interactions for analysis, as well as establish interrater reliability of coders. This preliminary work will conclude in May, providing strong foundation for completing the proposed dissertation study.

Experience and Resources

Our research team is currently completing a feasibility study, which aims to determine the feasibility, duration, adverse events, and improve overall study design for a full-scale research project. The research team consists of Caitlin Lisk, Dr. Lisa Mische Lawson (mentor), and three Masters of Occupational Therapy students for data collection and reliability. This project has the support of the University of Kansas Medical Center Occupational Therapy Education Department and has been approved by University of Kansas Medical Center Institutional Review Board.

Caitlin Lisk has a Master's in Social Work and is a PhD student in Therapeutic Sciences at the University of Kansas Medical Center. Caitlin is interested in the human-animal bond in children with ASD. She completed a scoping review of the available research, which indicates a need for valid measures within the human-animal bond field (Lisk & Mische Lawson, 2019, under review). Ms. Lisk has completed a coding course through Purdue University which provided training for use of the OHAIRE coding tool independently. This course was first

initiated in Fall, 2019, and to date, the OHAIRE has only been used to observe children with ASD in structured settings (e.g., schools, hospitals). Ms. Lisk plans to expand the use of this tool to naturalistic settings, specifically families' homes.

Dr. Lisa Mische Lawson will serve as the primary mentor for the proposed project. Dr. Mische Lawson is an associate professor in the Department of Occupational Therapy Education at KUMC. She has an extensive background in supporting families of children with ASD through the Sensory Enhanced Aquatics program. Her work has focused on promoting health of individuals with disability and chronic illness through leisure and physical activity, specifically swimming to improve body composition and sleep of children with ASD. With the research team's expertise and extensive research on the development of children with ASD, there is sufficient support to effectively complete the proposed project.

Timeline

We are proposing a 12-month project. During months 1-2, recruitment will begin with initial emails and phone calls to reach out to caregivers interested in participating. During months 2-4, we will collect videos from caregivers, and set-up times for interviews that match the availability of families and investigators. Interview sessions will include gathering qualitative data and receiving the SRS data. Following interviews, we will code interactions between months 3-6, and transcribe interviews verbatim during months 4-7. In order to provide the most descriptive and valid data, we will analyze data during months 6-9. During months 10-12, we will submit a summary of our findings, write a manuscript and predict submission to at least one high-impact journal. Please see the table below for further timeline information, depicting an overlap of events.

Activities	Months

	1	2	3	4	5	6	7	8	9	10	11	12
Recruitment	X	X										
Collect videos & Conduct		X	Х	Х	X							
interviews, SRS												
Code videos			X	X	X	X						
Transcribe interviews				Х	X	X	Х					
Data analysis						X	Х	Х	Х	Х		
Compare qualitative &									Х	Х		
quantitative findings												
Summary report										X	Х	
Dissemination											Х	Х

Methodology and Evaluation

Research Design

Due to the complexity of this social phenomena, the gaps in the available literature, and the innovative nature of this proposal, we are using a mixed method design to investigate the research questions. Our mixed methods approach involves a sequential explanatory design, where quantitative data is collected and analyzed (i.e. OHAIRE codes, SRS scale, family demographics) within the first phase of the research; the second phase involves qualitative data collection, which includes interviews with caregivers to address the second aim of the study. Mixed methods design includes determining the timing of data collection, when to analyze, how to integrate the data sets, and the priority for each approach (Creswell, 2009). Emphasis will be put on quantitative data as it is critical to objectively measure how children with ASD interact with animals in the home environment, and qualitative data will supplement and inform our quantitative data. Figure 1 details the proposed mixed methods design.

Figure 1. Sequential Explanatory Design Process adapted from Creswell (2009).



Participants

Due to the specific nature of this study, we will use purposeful sampling to receive in-

depth information for this research. Our inclusion criteria are as follows:

Caregivers will:

- 2) Provide daily care of child with ASD
- 3) Own and live with an animal
- 4) Speak and understand conversational English

Children will:

- 1) Be age 18 or younger
- Have an ASD diagnosis (DSM V); reported by parent and confirmed with SRS score > 59
- 3) Own and live with an animal
- 4) Be any gender

Animals will:

- 1) Be any age
- 2) Be any species
- 3) Live with family

The University of Kansas Medical Center Occupational Therapy Department has a large listserv of families of children with ASD who have expressed interested in research participation. We will use this listserv to recruit participants, and plan to enroll up to 30 children in this study. Children will be excluded if they do not own an animal, or if they are foster children or wards of the state. Children with co-occurring conditions will not be excluded and conditions will be systematically documented to inform results. Written caregiver consent and verbal assent of children able to provide it will be required to engage in the study.

Procedures

Following recruitment, interview questions and consent forms will be provided to caregivers via email or mail. Prior to the interaction, the caregivers will sign a consent waiver for participation in the research study. We will request caregivers film 10 minutes of naturally occurring interactions between their child and animals and provide these to researchers via secure file transfer. The purpose is to receive a depiction of the most natural interactions possible between the child and their animal.

After interactions have been recorded, we will schedule times to meet with caregivers at a time of their choosing for qualitative interviews and to obtain the SRS data. Caregivers will be interviewed in a private setting chosen by the participant. The interview is expected to last 30-60 minutes. The interviews will be semi-structured in nature and recorded for later analysis. During the interview, we will write field notes to record behavior, mannerisms, emotions, and interruptions (Creswell, 2009). Interviews will be transcribed, coded, and analyzed into themes for analysis.

Evaluation/Measures

OHAIRE Coding Tool (Guerin et al., 2018). The OHAIRE coding tool is a timed interval behavior coding system which quantifies social communication and interactions with animals (O'Haire et al., 2013). Specific categories within the OHAIRE coding tool determine social interaction, which include taking, touching, gesturing, looking, being intentionally helpful, and showing affection. These interactions are coded as directed towards adults (18+), peers (similar age), and/or animals. The interactions can be coded between the participant and any owned animal. Previous analyses of the OHAIRE coding tool within human-animal interaction research has shown good reliability, validity, and inter-rater reliability with children with ASD (Guerin et al., 2018).

The OHAIRE coding manual recommends video sessions be 10 minutes in duration for each participant (O'Haire et al., 2013; Martin & Farnium, 2002). The primary coder will code all video received from caregivers. Each 10-minute video will be divided into three parts, and oneminute video sections will be randomly chosen from each third and coded by a secondary rater. The OHAIRE coding manual recommends a secondary rater code 20% of the videos to ensure inter-rater reliability, reaching a Cohen's kappa of $k \ge .80$.

Social Responsiveness Scale (SRS; Constantino & Gruber, 2005). The SRS is a 65-item scale completed by parents or caregivers which measures the child's social abilities in natural settings. This scale is intended for children ages 4-18. The SRS has five components of social deficits including social cognition, social communication, social motivation, social awareness, and autistic mannerisms. Lower scores are associated with lower levels of social deficits, while

higher scores reflect more severe social impairments. This measure is widely accepted and has been used extensively in research of families of children with ASD.

Interview: We will use semi-structured interviews to gather information related to the lived experiences of families who own animals. These questions are based on a scoping review (Lisk & Mische Lawson, 2019, under review) of natural-based interventions of human-animal interaction for children with ASD completed by the primary investigator.

Research question: <u>What are the lived experiences of animal ownership in families of children</u> with ASD?

Open-ended interview questions include:

- 1. Tell me about your animal or animals (*identify the animal*).
- 2. What are your family's reasons for owning an animal?
 - a. Why this type of animal, over another?
- 3. How would you describe your child's relationship with your animal?
- 4. Tell me about a typical day between your child and your animal?
 - a. How much time does your child spend with their animal?
- 5. Are there activities your child does specifically with your animal?
- 6. Are there safety considerations to owning an animal?
- 7. Do you notice a difference in your child socially when your animal is present?
- 8. Are there challenges to owning an animal?
 - a. Estimated cost?
 - b. Caregiver burden?
- 9. Do you think owning a pet is important for your child? Why or why not?

- 10. Are there any factors about your child or family that influenced your decision to have an animal in your home?
 - a. Do these factors influence your child's bond with the animal?

Analysis

Quantitative. We will run descriptive statistics to determine mean family composition, family income, and age of child. The OHAIRE data will be analyzed to determine frequencies of specific pro-social behavior types, and the number of intervals per minute the participant engaged in such behaviors. This analysis will include verbal, visual, and physical behaviors, and the target of such behaviors. Further, we will determine the frequency of emotional displays (e.g. laughing, smiling, frowning) and problem behaviors (e.g. yelling, physical aggression) exhibited throughout the data.

The OHAIRE calculates a human-animal bond score to quantify the interactions taking place between the participant and the animal. This score ranges from 0-36, with six data segments that are scored per 60 second video. These data segments include talk, gesture, look, touch, affection, and purposefully helpful behavior. This score indicates social behaviors directed towards the animal throughout the video segment. Correlation analysis will be used to determine the relationship between the social interaction items within the OHAIRE coding tool, the humananimal bond score, and the social interaction subsets within the Social Responsiveness Scale (SRS).

Qualitative. Our qualitative analysis will follow Braun & Clarke's (2012) six phase approach to thematic analysis. The six phases involve: 1) familiarizing with the data, 2) generating initial codes, 3) searching for themes, 4) reviewing themes, 5) defining and naming themes, and 6) producing a report. Thematic analysis is an inductive process which allows for

the content of the data to develop the themes and codes and eliminates researcher bias or theoretical interests to drive the analysis. The primary researcher (Caitlin Lisk) will be involved throughout the following six phases. MOT students will assist with transcription and coding with Ms. Lisk's supervision.

We will transcribe interviews verbatim and each researcher will read the transcripts to understand the content. The first phase involves absorbing the meaning and the depth of the data by actively reading the words of the transcripts, deriving meaning, and potential ideas for coding. Note taking, discussion, and generating ideas for coding is encouraged during this phase (Braun & Clarke, 2006). Phase 2 involves reading the transcripts and identifying initial codes that synthesize the participant's meanings. Our team will meet and discuss our individual analyses to determine codes that will be used for further coding processes. In order to establish interrater reliability, we will code 50% overlap data, and our team must reach 80% agreement on the overlap data. Phase 3 will involve sorting the codes received from analysis into themes. This phase involves further synthesis to address similarities and differences between identified codes (Braun & Clarke, 2012). We will generate themes and subthemes and collapse complex codes into simplified versions of the code meanings. Agreement will be met between researchers regarding the consolidation of themes, and if consolidation does not occur, subthemes will be created. Our focus in this stage will be to tell an overall story of the concepts that participants are conveying within the interviews.

The fourth phase involves checking the quality of the created themes, and re-evaluating theme boundaries to include more codes, or to exclude existing ones. Braun & Clarke (2012) encourage collapsing themes together, splitting themes apart, or eliminating themes altogether with the goal to get the best representation of the data provided in the interviews. Once themes

are decided upon, we will re-read all the data to ensure the themes capture the overall meaning of the transcripts and verify validity of existing themes. Phase 5 involves determining how the themes are unique from one another and defining the interesting components of the supporting data within each theme. We will ensure a singular focus of each theme and compare definitions between themes to come to agreement of theme definitions. Braun & Clarke (2012) describe the final phase as comprehensive throughout the process of data gathering, emphasizing the need to provide a compelling story of the data that is representative of interviews. We will write the data analysis to be thorough, transparent, and authentically represent rich evidence of themes, utilizing quotations for emphasis. We will establish validity through peer review and rich description (Creswell, 2009).

Quantitative and Qualitative Analysis. When analysis is completed for both quantitative and qualitative data sets, we will begin to combine the data sets and interpret together. We are interested in learning how the qualitative information regarding parent experiences can help us understand the quantitative data from the Demographic form, Social Responsiveness Scale and OHAIRE coding outcomes. We will examine how the social skills items within the OHAIRE and the Social Responsiveness Scale align with the thematic analysis in the qualitative data set. We will member check results of the thematic analysis with 10% of participants and triangulate quantitative and qualitative results with existing literature to ensure validity.

Outcome Recommendations.

The purpose of the proposed design allows the researchers to quantitatively define naturalistic human-animal interactions. We expect the OHAIRE coding system will show children with autism positively interacting with animals in the home. We expect to see lower

SRS scores correlate with higher pro-social behaviors within the OHAIRE coding system. We also expect higher OHAIRE pro-social behaviors to positively correlate with higher humananimal bond scores. Further, we expect higher SRS scores to negatively correlate with humananimal bond scores. Overall, we hope to understand specific child characteristics, and how these relate to outcomes related to the SRS and the social skills items on the OHAIRE coding tool.

Due to the inductive nature of the study, we do not postulate outcomes for the qualitative piece of the proposed project, although we find immense value in the possibilities of the data. Gaining insight into the lived experiences of animal ownership for families may aid in future intervention methods surrounding aspects of social skill attainment, cost, and safety implications. Understanding factors related to family characteristics. It is critical to utilize rigorous research to determine what factors most influence animal ownership. In a scoping review of the literature (Lisk & Mische Lawson, 2019, under review), two of thirteen studies reported family income (Viau et al., 2010; Carlisle et al., 2018). These studies do not report family size and composition, and consequently this data does not assist with understanding income needs for pet ownership. Cost was associated with negative experiences for animal ownership (Burgoyne et al., 2014; Wright et al., 2016; Carlisle et al., 2018), therefore financial obligations should be considered for families incorporating animals into their homes. Studies also reported an increase in responsibilities of caring for the animals were difficult (Smyth & Slevin, 2010; Carlisle et al., 2018; Burgoyne et al., 2014), which emphasizes the importance of the qualitative interviews of our proposal for fully exploring potential positive and challenging aspects of pet ownership.

It is imperative to identify child and family characteristics such as age, income and ASD severity that will best respond to human-animal interactions. Some studies have sampled only "high functioning" children with ASD (Carlisle, 2014; Ward et al., 2017), while other studies

included individuals considered high functioning and lower functioning within the study (Hart et al., 2018; Wright et al., 2015; Burgoyne et al., 2014; Wright et al., 2016). Ward et al. (2017) showed the higher the child's IQ, the more likely the child would take responsibility in caring for the animal, and also the more likely the child would seek companionship from the animal; this study also found age was significantly positively associated with responsibility. Hart et al. (2018) found that children with less severe ASD had higher rates of affection towards animals. These results suggest the older the child, less severe the ASD, and the higher the IQ will lead to more responsibility and greater positive relationships with the animal. Some studies reported the severity of ASD as a consideration for the quality of the human-animal bond, however only one study provided practical recommendations based on results. Understanding individual characteristics for positive animal ownership may provide us with a better means to individually tailor recommendations for families considering introducing a pet to their home. Though this study will not assess IQ or ASD severity directly, the SRS will give indication of severity of social deficits and can serve as a consideration for ASD severity. We will also explore characteristics contributing to positive animal ownership through interviews.

Advancing innovative service delivery models. Animal-assisted interventions within the ASD population include sessions with a trained animal handler and a team of individuals whom implement these interventions in community-based settings for a limited amount of time. Animal-assisted interventions utilizing a trained provider and trained animal can require 400 hours of training (American Kennel Club, 2019) and can be costly for families. Exposure to animals in the home may be more accessible and provide similar benefits for families. Additionally, having an animal in the home may provide more sustainable effects through continued animal interaction since it does not require extensive training or travel to a therapist.

Guidelines established by Health Resources and Services Administration (HRSA) Autism Intervention Research suggest children with ASD should have access to at least 25 hours per week of non-medical interventions to encourage social skill attainment (Maglione et al., 2012). In a review of the literature, Cowan & Allen (2007) suggest naturalistic interventions can be a preferred method because of increased duration and frequency of interactions, which increase the overall effectiveness of the relationship for children with ASD. Because structured interventions are costly and require skilled providers, child-animal interactions in natural settings is an innovative way to provide social skill attainment and be more accessible for families faced with these barriers to care.

By examining the lived experiences, and quantifying the interactions of children and their animals, we may gain better insight into the benefits and challenges of naturalistic human-animal interactions in children with ASD. Through this study, our goal is to describe natural-based human-animal interactions for children with ASD and make recommendations that outline characteristics for which children prefer to, and benefit from, interacting with animals, and which do not. In addition to informing recommendations regarding animal ownership, these findings may also inform how natural human-animal interactions can be harnessed to improve social skills and social participation of children with ASD. Long-term, our natural human-animal interaction research may contribute to advocacy related to service, therapy and companion animals for individuals with ASD.

Further research. The current state of the research is limited in its ability to provide objective standardized measures of the human-animal bond. The OHAIRE (Guerin et al., 2018) is the first measurement tool available for research that could be helpful in quantitatively evaluating interactions to determine the effect of the human-animal bond. The OHAIRE measurement tool

has potential to expand current understanding of human-animal bond beyond parent report by providing reliable, objective observation data. Our project presents the first study to address qualitative and quantitative aspects using the OHAIRE coding tool in natural settings. Future research is needed to determine the traits and characteristics that are best suited for naturalistic human-animal interactions for families of children with ASD.

Our future plan involves applying for R03 Human-Animal Interaction (HAI) Research grant, which includes an application due date of November 2021. This particular grant invites applications to evaluate animal-assisted interventions for individuals with disabilities and determine the impact of human-animal interactions on atypical child development and health. These funding purposes align directly with the intent of this research and will support investigation of the complex nature of naturalistic human-animal interactions in children with ASD.

Practical Relevance

The proposed project seeks to address the everyday, practical challenges posed by ASD and parenting a child with ASD. Specifically, understanding the ways in which children interact with animals in their homes, in natural settings, is critical to challenging existing paradigms of intervention-based therapies. Intervention-based therapies can be costly and require trained providers, which may not be accessible to all families. Much of the current human-animal interaction research encourages the use of animals as an intervention (Pavlides, 2008; Grandin et al., 2015), and does not explore the effects of families owning an animal. Exposure to animals in the home may be more accessible and provide similar benefits for families. Families may be advised to bring an animal into their home based on the promising results from intervention-based research. However, pet ownership comes with unique responsibilities and challenges. Our

study will provide important insight into how children with autism engage with animals and caregivers' perceptions of the benefits and challenges of pet ownership. We will also describe child and family characteristics associated with favorable responses to having pets in the home so families can make informed decisions.

Parent perspectives of animal ownership will also inform future research as we use results of this pilot study to inform a larger effectiveness trial. Parent perspectives allow us to uncover what active ingredients are necessary for animal ownership, and what ways it can be the most effective with this population. Our mixed methods study allows us to learn from the families who already own animals, quantify social skills within human-animal interactions, and combine these data points to tell a full story of animal ownership in families of children with ASD.

The mission of the Organization for Autism Research is to "disseminate new and useful information to as many members of the autism community as possible," and "direct all research and programs initiatives toward enhancing the quality of life for individuals with autism" (Organization for Autism Research, 2020). Our research proposal aims to meet these goals by investigating new phenomena and addressing knowledge gaps within the autism community. This is the first study that will utilize the OHAIRE coding tool in families' homes, while also gaining qualitative perspectives to inform benefits and challenges of pet ownership. Families may feel pressured from social media or other families to introduce animals into their homes based on anecdotal positive experiences. The proposed study is essential to informing the risks and benefits of animal ownership so families can make informed decisions about the effects natural animal interactions may have for children with ASD.

Subject Protection

A copy of the IRB proposal for our current research project has been submitted, which

will be amended upon funding of our proposed project.

Budget

Organization fo	r Autism Research Grant Proposal								
Principal	Caitlin Lisk, Lisa Mische-Lawson								
Investigator									
Project Title	Coding Human-Animal Interactions in								
Funding Agency	Inding AgencyUniversity of Kansas Medical Center								
Budget Start	July 1, 2020								
Date									
Budget End Date	July 1, 2021								
Direct Costs	1	r							
Research	Description	Cost/Unit	Units	Total					
Materials									
	Paper copies (recruitment packets, data collection)	\$ 0.10	200	\$20.00					
	Postage (mail packages, prepaid	\$ 6.00	30	\$180.00					
	envelopes)			* * • • • •					
	Social Responsiveness Scale	\$ 59.00	1	\$59.00					
Participant Incentives	Gift Cards	\$ 25.00	30	\$750.00					
Transcription	Transcription costs, (\$20/hr) 30	\$ 20.00	15	\$300.00					
	participants, 1/2 hr interviews								
Travel to	Mileage (.58 per mile; 30	\$ 0.58	700	\$406.00					
participant	participants, 40 miles RT)								
homes									
	Total Direct Costs			1,715					
Administrative									
Costs									
Description			Units	Total					
		Cost/Unit							
Supportive	Binders	\$ 5.00	2	\$10.00					
materials	aterials								
D	Locked bags for transport	\$ 25.00	3	\$75.00					
Dissemination	Poster	\$ 200.00		\$200.00					
	Total Administrative Costs			\$285.00					
	Total Direct & Indirect Cost			\$2,000					

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Chapter 3: Coding Human-Animal Interactions in Homes of Children with Autism

Spectrum Disorders

Abstract

Autism Spectrum Disorder (ASD) is a developmental disorder characterized by differences in social functioning, communication, sensory, and behavior. These differences invite an effort to understand the human-animal bond and its impact on families and children with ASD. The purpose of this study was to determine if the Observation of Human Animal Interaction for Research (OHAIRE) coding tool can be utilized in a home-based setting to code human-animal interactions in children with ASD. The OHAIRE is a coding tool developed to quantify the behavior of children when interacting with social partners and animals in naturalistic settings. The tool has been tested for reliability and validity within structured, community-based settings, however, it has not been used in home-based settings. This study aimed to analyze the feasibility of utilizing the OHAIRE tool in home-based settings. The second aim was to determine if inter-rater and intra-rater reliability could be reached between coders using data from the home-based videos. Nine minutes of video was obtained for the study. Participant provided video was challenging to obtain and presented some coding challenges as quality differed from training videos. Participant training and incentives may increase usability of homebased video for coding interactions. Inter-rater reliability agreement was reached between primary and secondary coders ranging from .842 to .888. Intra-rater reliability was met with substantial agreement to almost perfect agreement and ranged from .792 to .929. The OHAIRE coding tool is a promising measure of in-home human-animal interactions that may require adaptations for coding home-based interactions. Further research should include testing in homebased settings with larger and more diverse sample sizes.

Keywords: Autism Spectrum Disorder, human-animal bonds, human-animal interactions, OHAIRE coding tool, social interactions.

Introduction

Autism-Spectrum Disorder (ASD) is a developmental disorder characterized by differences in social functioning, communication, sensory, and behavior. Centers for Disease Control estimate that 1 in 54 children are diagnosed with ASD (Maenner et al., 2020). A primary diagnostic criterion of ASD includes deficits in social skills such as social-emotional reciprocity, response to social interaction, and social communication including both verbal and nonverbal cues (American Psychological Association, 2013). Difficulties with social interactions and emotional understanding can lead to academic challenges, increased risk for peer rejection, victimization, social isolation, anxiety, and mood problems (Butterworth et al., 2014). The emergence of social skills and the establishment of interpersonal relationships are important aspects of child development (Fenning, Baker, & Juvonen, 2011). Recreational therapists often assist those with ASD with skill attainment and there is a growing need to develop effective strategies for children with ASD to improve social interaction skills with peers and adults.

Interventions utilizing human-animal interactions aim to improve social skills in children with ASD and can support physical activity, promote personal growth, and expand occupational skill sets (Fine & Beck, 2010). Literature on human-animal interaction encourages the use of animals to assist with sensory challenges and increase social skills among children with ASD (Grandin et al., 2015; Pavlides, 2008), and many of these interventions are supported by recreational therapists. Guidelines established by Health Resources and Services Administration Autism Intervention Research suggest children with ASD should have access to at least 25 hours per week of non-medical interventions to encourage social skill attainment (Maglione et al., 2012). In a review of the literature, Cowan and Allen (2007) suggest naturalistic interventions can be a preferred method because of increased duration and frequency of interactions, which

increase the overall effectiveness of the relationship for children with ASD. Natural-based animal exposure involves interactions between individuals and owned animals, under ordinary circumstances. Having an animal in the home may provide sustainable effects through continued animal interaction, as animal ownership does not require extensive training or travel to a therapist. Home-based interactions foster a naturally occurring bond and eliminate the stress of new environments and unfamiliar humans and animals, which is important for a population that relies on consistency and structure (Germone et al., 2019). Research shows the home environment is important for individuals with ASD, as many social interactions happen within the home environment versus community settings (Geisthardt, Brotherson, & Cook, 2002).

Despite the relevance of home-based environments, there is limited research on the effects of human-animal interaction in home-based settings. In a scoping review of the literature on animal exposure in natural settings, twelve of thirteen studies utilized parent report for identifying and quantifying the child-animal relationship (Lisk, Mische Lawson, Vaduvathiriyan, 2020). Research has shown parent report may not be a reliable or accurate measure for child behaviors (Geiger, Smith, & Creaghead, 2002; Hall & Segarra, 2007), and these surveys may not fully represent the nature of the relationship between child and animal. Studies show observational research allows the researcher to consistently and reliably identify behavior exhibited by children, which provides understanding of behavior frequency and duration, in addition to qualitative descriptors (Aspland & Gardner, 2003; Pesch & Lumeng, 2017). Observational research is a becoming a common and preferred method for understanding and measuring behaviors in naturalistic settings.

To fully understand this phenomenon, it is critical to use direct observation to objectively measure the interactions between children with ASD and animals in the home environment.
Observation methods have been used in previous research with ASD and animals (Grandgeorge et al., 2015; Grandgeorge et al., 2017), however no standardized measure is available for this field. The Observation of Human-Animal Interaction for Research (OHAIRE) (Guerin et al., 2018) is the first measurement tool available for research that could be helpful in quantitatively evaluating interactions to determine the effect of the human-animal bond. The OHAIRE measurement tool has potential to expand current understanding of human-animal bond beyond parent report by providing reliable, objective observation data.

The OHAIRE tool measures emotional displays, communication, social behaviors, and problematic behaviors within the human-animal interaction. In a review of four published studies, Guerin and colleagues (2018) found the OHAIRE has been used with a total of 201 participants ranging in ages from 5 to 18. These studies have utilized the OHAIRE with 14 coders and 2,732 minutes of video to code interactions in structured environments such as schools, inpatient hospital settings, group therapy settings, and therapeutic horseback riding programs. The environments included in these studies involved tasks and interactions that were not structured, however the locations involved controlled, structured settings. While researchers of the OHAIRE coding tool reached inter-rater and intra-rater reliability through these studies, research exploring the use of the OHAIRE tool in home-based settings has yet to be explored. Home-based interactions with animals involve unstructured environment and settings, and therefore look different from other naturalistic settings. Because of these differences, it is important to understand if human-animal interaction looks different in structured settings vs unstructured, home-based settings. This can further the field of therapeutic recreation by helping understand the therapeutic role animals play in the lives of children with ASD.

The primary aim of this study was to determine feasibility of using the OHAIRE coding tool in a home-based setting to code human-animal interactions in children with ASD. The second aim of this study was to determine if inter-rater and intra-rater reliability could be reached between coders using the data from the home-based setting videos.

Methods

Feasibility studies determine whether an intervention is appropriate for further testing (Bowen et al., 2009). Assessing the feasibility of a study allows researchers to determine whether the ideas and findings are relevant and applicable to the target population. For an intervention to be worthy of testing for efficacy, it must address the relevant questions within feasibility. The OHAIRE has been tested for reliability and validity within structured naturalistic settings, however it has not been used in home-based settings. This information is needed to understand the practical use of this tool for measuring naturalistic home-based interactions for children with ASD and their animals.

Participants

This study used purposeful sampling due to the specific nature of this feasibility study. After IRB approval, recruitment for participants occurred through an email listserv of a voluntary participant directory utilized for ongoing studies. Inclusion criteria for participants included the following: male and female children 17 years of age or younger, a diagnosis of ASD, and own/live with an animal. Foster children and wards of the state were excluded. Due to limited funding, the researchers did not provide compensation or incentive for participation in this study. Signed consent forms by caregivers or child were required for participation in this study. **Instrument**

The OHAIRE was designed specifically to quantify human-animal interactions and displays good reliability and validity in previous studies (Guerin et al., 2018). OHAIRE interactions included: interactive behaviors (social communication and environmental interactions), emotional display (facial and verbal), and interfering behaviors (aggression, overactivity, and isolation). Social communication is the interaction between the participant and another person. Social communication was coded for behaviors such as talk, gesture, look, touch, affection (e.g., cuddling, nuzzling, holding hands), and prosocial (purposefully helpful behavior). Environmental interactions are exchanges between the participant and the animal. Environmental interactive behaviors include talk, gesture, look, touch, affection, and prosocial. Researchers coded emotional displays as verbal (positive, negative, and/or none) and facial emotion (positive, negative, and/or none). Examples of verbal emotional display include verbally expressing happiness, excitedness, joy, disdain, annoyance, irritation, and neutral content with no emotion. Examples of facial emotion include smiling, laughing, frowning, crying, and whining. Interfering behaviors include aggression (e.g., throwing, kicking, swearing), overactivity (e.g., rough play, talking rapidly), and isolation (e.g., silence, non-participation). Full details of these domains can be found at www.ohairecoding.com.

Every instance of social communication or interactive behaviors included a target defined as a person, animal, or object. One-zero sample method was utilized for coding. For every ten second interval, if the behavior was present/absent in any part of the interval, the team coded behaviors as either present (1) or absent (0). The frequency or duration of interactions within each interval were not coded. If individuals or animals were not visible in the video frame, the OHAIRE training manual specifies the interaction is not coded. Researchers utilized ELAN (ELAN, 2019) software to cut the videos into ten second intervals per minute. The team used

Qualtrics (Qualtrics, 2020), an online survey software, to enter scores to code data with OHAIRE.

Reliability of data collection can increase consistency and improve confidence and accuracy (McHugh, 2012). Inter-rater reliability increases trustworthiness across more than one data collector and removes subjectivity from data observation. Intra-rater reliability can assess accuracy among raters, and address observer drift over time after inter-rater reliability has been established (Chorney, McMurtry, Chambers, & Bakeman, 2015). The researchers in this study were trained consistently on the OHAIRE coding tool to increase reliability and reduce the potential of subjectivity. Data was categorized to determine inter-rater and intra-rater reliability for emotional display, environmental interactions, and interfering behaviors.

Data Collection Procedures

Upon meeting inclusion criteria, caregivers reviewed, completed, and submitted consent forms to participate in the study. Researchers requested a minimum of ten minutes of film that involved naturally occurring interactions between the child and animal(s) within the home. Researchers directed the participants to interact naturally with their animal in their home environment rather than perform specific tasks. The caregivers were not given instruction on how to record video, but to use video to depict typical interactions that occur in the home. The team asked caregivers to provide video files via secure file transfer. The intent of requesting filmed interactions was to reduce environmental interference of strangers in the home, and capture the most natural interactions possible between the child and their animal.

Research Records. The research team collected demographic information and systematically recorded information to inform feasibility of using the OHAIRE in home settings. Records included: communication between researchers and participants (frequency and

methods), number of participants enrolled and consented, number of participants providing data, and usability of data provided.

Coders

Five researchers acted as coders for this study. One coder was designated as the primary coder, and four were considered secondary coders. The OHAIRE manual instructs the primary coder to code the full set of videos and the secondary coders to code a minimum of 20% of the videos obtained for the study. Because the second aim of the study was to establish reliability, all videos were coded by primary and secondary coders instead of the suggested minimum 20%.

Training

All coders were trained using the training protocol provided by OHAIRE to learn the coding system. The training began with weekly meetings involving a detailed overview of the manual, along with viewing practice videos to provide examples of each behavior. Once each coder thoroughly read and understood the manual, the primary investigator/coder taught secondary coders to use Qualtrics to record training data. The training involved practice coding videos independently and discussing behavior definitions within the OHAIRE manual with the primary coder. After training, the secondary coders coded three, one-minute videos provided by the OHAIRE research team and independently entered responses into Qualtrics. Each researcher was required to meet at least .80 reliability across overall categories during training prior to coding participant data.

Data Analysis

To analyze feasibility data for the first aim, the authors used descriptive statistics to summarize research records. To evaluate reliability for the second aim, the authors used kappa statistic and descriptive statistics including frequencies and percentages. Cohen's kappa is used

to determine degree, significance, and sampling stability of the distribution of agreement between researchers, while limiting the chance for random agreement (Cohen, 1960). The kappa coefficient is a statistical measurement of reliability for quantitative data. It is recommended that the kappa result be interpreted as "values ≤ 0 indicating no agreement, .01 to .20 as none to slight; .20 to .40 as fair; .41 to .60 as moderate; .61 to .80 as substantial; and .81 to 1.00 as almost perfect agreement" (McHugh, 2012, p.278). The OHAIRE training manual provided syntax to run these analyses. SPSS version 25 (IBM Corp, 2017) was used for all data analyses.

Results

Participant Demographic

For this study, six participants enrolled, five consented, and two provided data. Both participants were males with a primary diagnosis of ASD, indicated per parent report. The participants each had presence of a co-occurring condition of Attention Deficit Hyperactivity Disorder (ADHD), and one had a diagnosis of anxiety. The participants were both Caucasian, with family income that ranged from \$80,001-\$100,000. The participants' caregivers were asked to describe their child's relationship with their family pets. One participant's relationship was described as, "loving and knowing. He is an animal lover, he just knows how to approach and interact with all living things (except bees)." The other participant's relationship was described as "pretty good but sometimes they play too rough." Table 1 displays a summary of participant demographic information.

Feasibility

A total of nine minutes of video was provided after three requests, and participants stopped responding to requests for additional video after four attempts. The caregiver of participant one sent three minutes of video in two separate video segments; the caregiver of

participant two sent six minutes of video in three separate video segments. Neither family provided the full ten minutes of video requested by the research team.

The coders found discrepancies between the videos received in home-based settings compared to videos provided in training sessions. Training videos were structured and recorded with a stationary camera, whereas participant videos collected for this study were recorded with mobile devices and frequently moved around to capture the unstructured animal-child interaction. This movement caused distorted and blurry videos at times. Additionally, the distance at which interactions were filmed varied between participants, causing the participant and animal to be out of the frame in some segments. Further, there were behaviors displayed in the participant session that did not occur in the training videos, requiring coders to interpret some behaviors. Examples of these behaviors include: attempting to feed the animal food it should not eat, limited initiation of interacting with pets, repetitive, non-directive speech, and displaying flat affect for the duration of the videos.

Of the participant videos provided, 18 ten-second segments (38% of total video) included interactions the OHAIRE coding manual required to be coded as "obscured" or interactions unable to be coded. In three separate ten-second segments (6% of total video), the child was out of the frame, and in six, ten-second segments (13% of total video), there was no animal observed in the frame. In six, ten-second segments, (13% of total video) the individual filming communicated with the participant in the video. Communication between the person filming and the child participant included comments such as "you might need to go to him (the animal)" and "don't give the cat pepperoni." In three, ten-second segments (6% of total video), the participant was responding to communication from the caregiver.

Inter-rater Reliability

Cohen's kappa between primary and secondary coders for the OHAIRE coding system and for the four categories of behaviors are presented in Table 2. The kappa values were interpreted using Cohen's statistical measures ranging from no agreement to almost perfect agreement (McHugh, 2012). Overall, inter-rater reliability was almost perfect with kappa values ranging .842 to .888 for both training and participant sessions.

Emotional display, including both facial and verbal, were coded with substantial agreement ranging from .723 to .874 for both training and participant sessions. Researchers coded the behavior data with almost perfect agreement with scores recorded between .874 to .908 for participant sessions. Environmental interactions coded during the training session were within the almost perfect category, ranging from .822 to .888. The environmental interactions for the participant session were lower compared to the training session, ranging from .774 to .864, which is considered substantial agreement. Social communication was not coded in the participant sessions because social communication requires interaction between two people, and these interactions were limited to those with the caregiver outside the frame or only the participant and the animal.

Intra-rater Reliability

Intra-rater reliability was used to test how similarly the same rater would code participant data multiple times. Coding occasions were separated by one month duration and were calculated using all participant video. Total Cohen's kappa ranged from .792 to .929 among the five coders (see Table 3), indicating intra-rater reliability was met with substantial agreement to almost perfect agreement for all coders.

Discussion

The primary aim of this study was to determine feasibility of using the OHAIRE coding tool in a home-based setting to code human-animal interactions in children with ASD. The second aim of this study was to determine if inter-rater and intra-rater reliability could be reached between coders using the data from participant provided home videos.

Feasibility

Participant recruitment was challenging for this study, which may have been due to the method of recruitment. Participants and their caregivers were recruited through a listserv by email only, and follow up was provided by phone once interest was established. Yet literature indicates in-person meet and greets, establishing oneself as a caring individual in the community, and attending autism community events are better ways to recruit for research studies (Wright, 2016). Further, this research indicates social media can also expand outreach opportunities to members of the community.

To encourage active participation in research after obtaining consent, it may have been beneficial to offer a motivating incentive for the participants and their families. Haas and colleagues (2016) conducted a study which aimed to find factors determining successful research participation in individuals with ASD. They found that motivators for the individuals included: furthering research for others with ASD, recognition and extrinsic rewards, opportunity for personal development, and being updated on the progress of the study. In contrast, they found that common inhibitors included travel and time commitments. While the families in this study did not have any travel concerns, they did have to commit their time to record and submit the videos with the only motivator being to further research related to ASD.

There were inconsistencies between the training and participant videos in the way they were filmed, including: unpredictable filming (close-up or too far away in proximity to the

child), blurry images, and participants' lack of appearance in the frame. These inconsistencies could be due to the lack of training or education caregivers received on how to properly film. Training of participants on the use of video recording and equipment, while being careful not to influence video outcomes, is encouraged in participatory video research (Derry et al., 2010; Milne, Mitchell, & DeLange, 2012; White, 2003). The underlying aim of participatory methods is to build capacity and empower individuals and families by giving control of the camera and process, and allowing individual experiences to be visible to researchers (Milne et al., 2012). Some research argues for installing cameras, or environmental sensors, in the home for 'raw footage,' which involves wide angle cameras, and allowing panning and zooming to capture events over long periods of time (Derry et al., 2010; Intille et al., 2003). Further, some studies have shown efficacy in multi-channel video, which allows for more cameras to capture different aspects of the interactions, as well as back up camera's in place for possible camera malfunction (Asan & Montague, 2014). Video practices such as these can increase validity to the video data and remove coding difficulties from poor video quality and lack of participant appearance.

While all secondary coders reached reliability with the primary coder for training and participant sessions, there were inconsistencies in training and participant videos. Research evaluating instrument development in the human-animal interaction field shows there is no one, universal measure that will suit all research studies (Wilson & Netting, 2012). Such a tool would require so many compromises, it would likely be difficult to implement in any setting. The OHAIRE tool shows promise that it was feasible to obtain reliability of coders despite new situations arising in the participant videos. Further training videos for home-based settings should include home-based interactions with a variety of scenarios. Training will allow coders to

become more comfortable recognizing behaviors seen in this study such as avoiding eye contact, or communicating or interacting with individuals out of frame.

Reliability

Secondary coders reached almost perfect agreement with the primary coder using the OHAIRE coding tool to code unstructured interactions in homes. Though both inter-rater and intra-rater reliability were good, there were some limitations using the OHAIRE tool in homes. The OHAIRE coding tool measures participant and animal interaction, as well as person to person interaction. Person to person interactions described in previous research included interactions with peers and teachers or therapists as they engaged in a structured activity together (Geurin et al., 2018). However, in this study the participants were observed communicating with the caregiver who was outside of the video frame, which is not coded with the OHAIRE tool. These meaningful interactions between the caregiver and child are not captured by the current version of the tool. Research on developing and modifying behavioral coding schemes encourage considering an analytic plan when developing a coding tool to determine how natural behaviors will be observed and scored, and the effect this has on the data (Chorney, McMurtry, Chambers & Bakeman, 2015). Further, research suggests it is important to study and understand the behavior in natural settings and *then* develop the technology or tools to capture desired interactions (Intille et al., 2003). If the OHAIRE coding tool is to be used in home-based settings, it would be important to modify aspects of the tool to capture the meaningful interactions occurring between participants in and out of the frame.

Strengths and Limitations

Though researchers included tools to increase rigor, limitations did exist. Due to the relatively small sample size of the study (n = 2) and lack of diversity between the participants

(both Caucasian males), the results of the study cannot be generalized to the general ASD population. Also, the home-based videos were filmed by a caregiver, which allowed for truly naturalistic interactions between the child and animal, but limited the video quantity and quality. Additionally, video captured interactions with the caregiver that were out of the frame. Capturing truly naturalistic interactions, even when out of frame, is a strength of the study. However, this strength uncovered a weakness of the OHAIRE tool for failing to capture these meaningful interactions.

Future Considerations

Future research should include extensive recruiting and incentivizing caregivers to increase sample size, diversity of sample, participation for the duration of the study, and quality of data/videos. Researchers should provide training for families on video etiquette, which could include meeting parents to guide where to focus the camera or provide alternatives for setting up video in the home. Studies should obtain a larger, more diverse sample size, particularity in terms of ASD symptomology and severity. Although ASD is a spectrum disorder that varies in clinical characteristics and severity, this study did not measure ASD severity or use it as an inclusion factor. Future research may benefit from incorporating severity levels and other characteristics (e.g., sensory preferences, verbal skills, etc.) to further understand feasibility of coding interactions of diverse populations with the OHAIRE tool to provide more generalizable results.

Conclusion

The OHAIRE coding tool was created as an instrument to quantitatively measure interactions between humans and their animals. Previous studies have focused on the coding tool's use during controlled activities, whereas the purpose of this study was to evaluate its

effectiveness during unstructured interactions in a home-based setting. Though there was some difficulty obtaining usable data, researchers in this study were able to successfully reach interrater and intra-rater reliability using the OHAIRE tool to code the home-based participant videos. The OHAIRE is a promising tool for quantifying the human-animal bond during naturalistic interactions in home-based settings, with some modification, and can help us understand the therapeutic efficacy of these interactions. Future research should replicate this study with a larger, more diverse sample of individuals with ASD to ensure the OHAIRE is usable with individuals with diverse ASD characteristics.

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Table 1

Characteristic	Participant 1	Participant 2	
Age	12	8	
Sex	Male	Male	
Diagnosis	ASD^*	ASD*	
Co-occurring conditions	ADHD** & Anxiety	ADHD**	
Race	Caucasian	Caucasian	
Household members	3	4	
Household income	\$80,001-\$100,000	\$80,001-\$100,000	
Animals in home	2 (cats)	3 (1 dog & 2 cats)	
Hours spent with pet per week	40-50 waking hours; 50-60 sleeping hours	3-4	

Participant Demographic Information

* Autism Spectrum Disorder

** Attention Deficit Hyperactivity Disorder

Table 2

	Primary vs.	Primary vs	Primary vs	Primary vs
	Coder 1	Coder 2	Coder 3	Coder 4
Training Session				
Total Kappa	.882	.880	.888	.850
Emotional Display	.745	.874	.766	.766
Environmental Interactions	.888	.862	.894	.822
Interfering Behaviors	.987	1.0	.974	.974
Social Communication	.797	.728	.819	.767
Participant Session				
Total Kappa	.842	.881	.872	.828
Emotional Display	.723	.774	.784	.753
Environmental Interactions	.793	.864	.854	.774
Interfering Behaviors	.899	.908	.898	.874
Social Communication				

Training & Participant Cohen's Kappa Values for Interrater Reliability

Table 3

	Primary Coder	Coder 1	Coder 2	Coder 3	Coder 4
Participant Session					
Total Kappa	.939	.862	.908	.792	.805
Emotional Display	.983	.829	.914	.772	.655
Environmental Interactions	.910	.818	.865	.667	.732
Interfering Behaviors	.910	.875	.941	.907	.908
Social Communication					

Cohen's Kappa Values for Intrarater Reliability

Chapter 4: Investigating Human-Animal Interactions in Homes of Children with Autism

Spectrum Disorders: A Mixed Methods Approach

Introduction

Animal-assisted interventions are increasingly being utilized as methods of complementary therapy in many populations. These interventions include sessions with a trained animal handler and a team of individuals who implement these interventions in communitybased settings for a limited amount of time. A recent review of the literature indicates animalassisted intervention can decrease agitation and aggression and increase quality of life and social interactions when introduced to individuals with dementia (Yakimicki, 2019). Further review of the literature showed animal-assisted interventions have been beneficial for individuals who have experienced trauma, particularly those diagnosed with posttraumatic stress disorder (PTSD), citing reduced depression, anxiety, and symptoms of PTSD (O'Haire, Guérin, & Kirkham, 2015). Animal-assisted interventions may also relieve pain and anxiety for children (Barker, 2015; Braun, Stangler, Narveson, & Pettingell, 2009), improve cognitive function and mood of individuals with Alzheimer's (Menna et al., 2016), and be calming, socializing and motivating for individuals with attention-deficit/hyperactivity disorder (Busch et al., 2016). Research has consistently shown animal-assisted therapies can be beneficial for mental and physical needs within vulnerable populations.

Centers for Disease Control estimate that 1 in 54 children are diagnosed with Autism Spectrum Disorder (ASD) (Maenner et al., 2020). Due to the prevalence of ASD and interest in animals as complementary therapy, there is a growing effort to understand the human-animal bond and the impact on families with children with ASD. Primary diagnostic criteria of ASD include differences in social skills involving social-emotional reciprocity, response to social interaction, and social communication including verbal and nonverbal cues (American Psychiatric Association, 2013). Due to these differences, many children with ASD have

difficulty bonding with loved ones and can have episodes of elopement and irregular mood and behavior (United States Department of Health and Human Services, 2015).

Researchers began exploring the idea of animal-assisted interventions in children with ASD in the 1980's (Redefer & Goodman, 1989). Animal-assisted interventions involve animals, often highly trained, introduced to children over a select amount of time to provide a particular outcome in behavior. Much of the current human-animal interaction literature encourages training animals to assist with sensory challenges and increase social skills among children with ASD as an intervention approach (Grandin et al., 2015; Pavlides, 2008). Many studies focus on animal-assisted interventions for improving specific outcomes for children with ASD (O'Haire, 2013), and do not explore the effects of human-animal interactions provided through animal ownership.

Natural-based animal exposure involves interactions between individuals and owned animals (i.e., pets), under ordinary circumstances. In a recent scoping review of natural-based animal exposure for children with ASD, thirteen articles met criteria for inclusion, which comprised of peer reviewed journals, with the primary focus on children with ASD studying the impact of animals in the home environment (Lisk, Mische Lawson, & Vaduvathiriyan, 2020). This review showed each study utilized different measures indicating there were no consistent tools used to measure the human-animal relationship. Further, the relatively small number of controlled trials make evidenced-based recommendations for animal ownership difficult. The available research suggests study of human-animal bond in natural settings is exploratory and preliminary in nature, with significant gaps including lack of objective observations of interactions in home environments where children and animals interact, and lack of information

about the downsides of animal ownership. It is critical that future studies explore these literature gaps to lay the groundwork for effectiveness and longitudinal studies.

Key Findings of Human-Animal Bond

Much of the natural-based animal exposure research show positive outcomes for social skills and relationships for children with ASD. Social skills refer to the behaviors that can increase or predict healthy social normative outcomes, such as communication and peer acceptance (Elliot & Gresham, 1987). Many studies outline the love, companionship and increased communication children gain from having an animal in the home (Burgoyne et al., 2014; Burrows, Adams, & Spiers, 2008; Bystrom & Lundqvist Persson, 2015; Carlisle, 2014; Carlisle et al., 2018; Grandgeorge et al., 2012; Hart et al., 2018; Harwood, Kaczmarek, & Drake, 2019; Smyth & Slevin, 2010; Ward, Arola, Bohnert, & Lieb, 2017; Viau et al., 2010; Wright et al., 2015; Wright et al., 2016). One quantitative study utilized the Family Assessment Measure Version III to determine that family functioning and relationships were significantly improved within the group of animal-owners, versus the group of non-owners (Wright et al., 2015). A follow-up study by the same authors revealed animals in the home led to enhancement of family dynamics, encouragement of activities, and provided a way for the child to be included within the family (Wright et al., 2016). A survey of high-functioning children with ASD showed a child was more likely to feel companionship from the animal if he or she had responsibilities associated with caring for the animal (Ward, Arola, Bohnert, & Lieb, 2017). Though many studies showed benefit, one study (Carlisle, 2014) found no significant differences in children's total social skills scores between dog owners and non-dog owners within the Social Skills Improvement System Rating Scale (SSiS-RS). Although there was no difference in total scores, there was a significant difference in the assertation subscale which includes initiating a social

exchange (e.g., asking questions, prompting discussion) with another person in a social setting, which has implications for enhancing child inclusion and family dynamics.

Qualitative evidence shows comparable findings. Carlisle et al. (2018) asked caregivers to describe their relationships with animals through write-in interviews. Of the 338 caregivers interviewed, researchers found that the primary benefit of living with the animal was the companionship from the non-judgmental relationship. One study indicated the child would have long conversations with the animal, which the authors determined to be encouraging socialization skills and could assist with communication barriers for the children (Bystrom & Lundqvist Persson, 2015). Further, Smyth and Slevin (2010) found that the animal acts as a catalyst for social interactions in public, encouraging community integration and discouraging isolation which can be common in families with a child with unpredictable behavior. Qualitative methodology for the aforementioned studies varied in rigor, with lack of transparency of interview questions and analysis in some studies.

Two qualitative research studies and one mixed methods study investigated experiences of animal ownership among families with a child with ASD and revealed the importance of safety and security when animals are in the home (Burgoyne et al., 2014; Burrows, Adams, & Spiers, 2008; Smyth & Slevin, 2010). Burrows and colleagues (2008) found that the service dog allowed parents to remove locks and alarms on doors, which were previously in place to provide safety and prevent the child from wandering. Further, the animal would sleep with the child at night and wake the parents if the child was upset or if anything went awry, which helped the family feel less worry. This study utilized researcher observation of the human-animal interaction within the home and community. Smyth and Slevin (2010) interviewed seven parents and found that the animal prevented the child from running into traffic or eloping to a dangerous

scenario. Parents reported that the dog would continually track the child and bark or pace to alert parents if something was wrong. This presence of the animal provided security in public and made social outings more manageable for parents and the child. Further, researchers compared the perceived safety of individuals with a service dog, and those on the waitlist for a service dog by using a questionnaire that measured environmental hazards, perceived competence, and caregiver strain (Burgoyne et al., 2014). Results showed those with a service animal had significantly higher perceived safety than those without.

Studies of natural-based animal exposure have shown positive mental health outcomes for children with ASD (Bystrom & Lundqvist Persson, 2015; Smyth & Slevin, 2010; Viau et al., 2010; Ward, Arola, Bohnert, & Lieb, 2017; Wright et al., 2015; Wright et al., 2016). These studies found that the companion animal offered comfort and a mode for coping in times of stress and anxiety in community settings and in the home. Three studies report the animal eased depressive symptoms and encouraged joy and resiliency within the child (Bystrom & Lundqvist Persson, 2015; Smyth & Slevin, 2010; Ward, Arola, Bohnert, & Lieb, 2017). Wright and colleagues (2015) utilized the Spence Children's Anxiety Scale and showed lower anxiety scores including obsessive compulsive disorder, panic attack and agoraphobia, social phobia, and separation anxiety in the dog-owning group, compared to the non-dog owning group. Viau and colleagues (2010) showed a 48% decrease in cortisol levels in children with a service dog in the home. A qualitative study of seven individuals by Smyth and Slevin (2010) found parents reported the children show less anxiety, fewer tantrums, improved coping skills, and stated their child's depression was "relieved" when with their animal.

Child and Family Characteristics

It is critical to utilize rigorous research to determine what factors most influence animal ownership. In a scoping review of the literature (Lisk, Mische Lawson, Vaduvathiriyan, 2020), two of thirteen studies reported family income (Carlisle et al., 2018; Viau et al., 2010). These studies do not report family size or composition, and consequently this data does not assist with understanding income needs for pet ownership. Cost was associated with negative experiences for animal ownership (Burgoyne et al., 2014; Carlisle et al., 2018; Wright et al., 2016), therefore financial obligations should be considered for families incorporating animals into their homes. Studies also reported increased responsibilities of caring for the animals were difficult (Burgoyne et al., 2014; Carlisle et al., 2010), which emphasizes the importance of qualitative interviews to fully explore potential positive and challenging aspects of pet ownership.

It is imperative to identify child and family characteristics such as age, income and ASD severity that will best respond to human-animal interactions. Some studies have sampled only "high functioning" children with ASD (Carlisle, 2014; Ward, Arola, Bohnert, & Lieb, 2017), while other studies included individuals considered high functioning and lower functioning within the study (Burgoyne et al., 2014; Hart et al., 2018; Wright et al., 2015; Wright et al., 2016). Ward, Arola, Bohnert, & Lieb (2017) showed the higher the child's intelligence quotient (IQ), the more likely the child would take responsibility in caring for the animal, and also the more likely the child would seek companionship from the animal; this study also found age was significantly positively associated with responsibility. Hart et al. (2018) found that children with less severe ASD had higher rates of affection towards animals. These results suggest older age, less severe ASD, and higher IQ will lead to more responsibility and greater positive relationships with the animal. Some studies reported the severity of ASD as a consideration for the quality of

the human-animal bond, however only one study provided practical recommendations based on results. Understanding individual characteristics for positive animal ownership may provide us with a better means to individually tailor recommendations for families considering introducing a pet to their home.

Service Delivery

Animal-assisted interventions utilize a trained animal handler and a team of individuals who implement these interventions in community-based settings for a limited amount of time. Animal-assisted interventions utilizing a trained provider and trained animal can require 400 hours of training (American Kennel Club, 2019) and can be costly for families. Exposure to animals in the home may be more accessible and provide similar benefits for families. Additionally, having an animal in the home may provide more sustainable effects through continued animal interaction since it does not require extensive training or travel to a therapist. Guidelines established by Health Resources and Services Administration Autism Intervention Research suggest children with ASD should have access to at least 25 hours per week of nonmedical interventions to encourage social skill attainment (Maglione et al., 2012). In a review of classroom literature, Cowan and Allen (2007) suggest naturalistic interventions can be a preferred method because of increased duration and frequency of interactions, which increase the overall effectiveness of the relationship for children with ASD. Because structured interventions are costly and require skilled providers, child-animal interactions in natural settings is an innovative way to provide social skill attainment and may be more accessible for families faced with these barriers to care. By examining the lived experiences, and quantifying the interactions of children and their animals, we may gain better insight into the benefits and challenges of naturalistic human-animal interactions in children with ASD.

Human-Animal Bond Measurement

Research of human-animal bond is hindered by lack of consistent tools used to measure the human-animal relationship. Many studies utilize researcher-created rather than valid or standardized tools to measure the human-animal bond among children with ASD (Burrows, Adams, & Spiers, 2008; Bystrom & Lundqvist Persson, 2015; Carlisle et al., 2018; Hart et al., 2018; Harwood, Kaczmarek, & Drake, 2019; Smyth & Slevin, 2010). Research utilizing standardized measures lacks consistency across studies. Commonly used measures include the Social Skills Improvement System Rating Scale (SSiS-RS), Companion Animal Bonding Scale (Carlisle, 2014), Youth Self Report-Depression Scale, Loneliness Scale, Loneliness Scale-Parent, Friendship Quality Questionnaire Parent (Ward, Arola, Bohnert, & Lieb, 2017), Perceived Competence Scale, Caregiver Strain Questionnaire, adapted Neighborhood Environment and Walkability Scale (Burgoyne et al., 2014), Brief Version of the Family Assessment Measure -III, and Spence Children's Anxiety Scale (Wright et al., 2015).

Carlisle (2014) utilized the Companion Animal Bonding Scale (CABS), which is an eight question Likert scale that aims to identify ways the respondent interacts with their animal. This scale includes items such as cleaning up, traveling with, holding or petting, sleeping near, and responsible for care of the animal (Poresky et al., 1987). This study asked the children with ASD to complete this survey, however the CABS has only been validated with the typical population and has not been validated with the ASD population. Further, children with ASD are typically not the primary caretaker of the animals in the home, as this responsibility falls to the parents; therefore, tools such as these may not be relevant or valid within this population.

In a scoping review of the literature on animal exposure in natural settings, twelve of thirteen studies utilized parent report for identifying and quantifying the child-animal

relationship (Lisk, Mische Lawson, Vaduvathiriyan, 2020). Research has shown parent report may not be a reliable or accurate measure for child behaviors (Geiger, Smith, & Creaghead, 2002; Hall & Segarra, 2007), and these surveys may not fully represent the nature of the relationship between child and animal. Studies show observational research allows the researcher to consistently and reliably identify behavior exhibited by children, which provides understanding of behavior frequency and duration, in addition to qualitative descriptors (Aspland & Gardner, 2003; Pesch & Lumeng, 2017). Observational research is becoming a common and preferred method for understanding and measuring behaviors in naturalistic settings. To fully understand this phenomenon, it is critical to use direct observation to objectively measure the interactions between children with ASD and animals in the home environment.

The Observation of Human-Animal Interaction for Research (OHAIRE) is the first measurement tool for quantitatively evaluating interactions to determine the effect of the humananimal bond (Guerin et al., 2018). The OHAIRE measurement tool has potential to expand current understanding of human-animal bond beyond parent report by providing reliable, objective observation data. This tool measures emotional displays, communication, social behaviors, and problematic behaviors within the human-animal interaction. The developers of the OHAIRE have published four studies with a total of 201 participants ranging in ages from 5 to 18 (Guerin et al., 2018). These studies have utilized the OHAIRE with 14 coders and 2,732 minutes of video to code interactions in structured conditions such as schools, inpatient hospital settings, group therapy settings, and therapeutic horseback riding programs. While researchers of the OHAIRE coding tool reached inter-rater and intra-rater reliability through these studies, research exploring the use of the OHAIRE tool in home-based settings has yet to be explored. It is important to understand if human-animal interaction looks different in structured settings

versus home-based settings. A feasibility study of individuals with ASD with nine minutes of video showed that the OHAIRE coding tool was feasible for use in home-based settings, but it was not adequate in describing the interactions fully (Lisk & Mische Lawson, 2020, manuscript submitted for publication). Recommendations from this study include further testing in home-based settings with larger and more diverse sample sizes.

Problem Statement

Animal-assisted interventions are effective in improving social skills in children with ASD, however they are inaccessible, costly, and time consuming. Naturalistic interventions in the home are promising, however we have limited knowledge of who may benefit from having an animal in the home. Further, current research of animal-human bond is hindered by measurement limitations of human-animal interactions. This study expands the use of the OHAIRE coding tool to measure human-animal interactions in the home environment. Research aims include:

1). To examine the heterogeneity of interactions between children with ASD and their animals in their homes.

2). To explore the lived experiences of animal ownership in families of children with ASD.

I used a mixed methods study design to explore the experiences and natural interactions children with ASD have with their animals in their homes. I hypothesized that children with ASD will have positive interactions with their animals based on the OHAIRE score. Qualitative methods involve an emergent design from a naturalistic inquiry of research (Sandelowski, 2000), which includes gathering data without guidance by *a priori* hypotheses.

Methods

Due to the complexity of this social phenomena, gaps in the available literature, and the innovative nature of this proposal, I used a mixed method design to investigate the research questions. This approach involved a sequential explanatory design, where quantitative data are collected and analyzed (i.e., child-animal interaction data collected with OHAIRE codes, ASD severity measured by the SRS scale, and child and family demographics) within the first phase of the research; the second phase involved qualitative data collection, which included interviews with caregivers, guided by quantitative data, to address the second aim of the study. Mixed methods design includes determining the timing of data collection, when to analyze, how to integrate the data sets, and the priority for each approach (Creswell, 2009). Emphasis was put on quantitative data, as it is critical to objectively measure how children with ASD interact with animals in the home environment; I used the qualitative data to supplement the quantitative data collection and analysis. Figure 1 details the mixed methods design.

Figure 1. Sequential Explanatory Design Process adapted from Creswell (2009).



Sample

Mixed Methods research requires the researcher to carefully consider study aims to determine the best sampling method which might include probability sampling, purposive sampling, or both (Teddlie & Yu, 2007). I used purposive maximum variation sampling to identify individuals who had differences in age, ASD severity, and family income. Purposive maximum variation sampling provides opportunity to find patterns within cases and identify heterogenous traits that emerge from the sample (Palinkas et al., 2015). Purposive sampling allows the researcher to utilize expert judgment to select individuals to maximize understanding of a particular phenomenon and will provide significant meaning to research data. It is important to identify shared observations across the sample to describe child and family characteristics associated with favorable responses to having pets in the home.

My primary aim was to examine heterogeneity of interactions between children with ASD and their animals. My previous research revealed recruitment challenges for this population, so I balanced the need for heterogeneity and practicality of conducting the study. I aimed to recruit at least 10 participants with differing age, autism severity and family income. Autism research shows children respond differentially based on age and autism severity and 10 participants is adequate for exploring differences (Mische Lawson & Little, 2017).

Inclusion criteria for child participants were the following: male and female children ages 4 to 17, a diagnosis of ASD, and own/live with an animal. Inclusion criteria for caregiver participants included: any age, provide daily care of child with ASD, own and live with an animal, and speak and understand conversational English. Children were excluded if they did not own an animal, or if they were foster children or wards of the state. Children with co-occurring conditions were not excluded. Written caregiver consent and verbal assent of children able to provide it was required to engage in the study.

Best-practice recruitment methods for ASD research include face-to-face interactions with potential participants (Wright, 2016), however due to pandemic-related challenges, I was unable to utilize in person connections. The University of Kansas Medical Center (KUMC) Occupational Therapy Department has a large listserv of families of children with ASD who

expressed interest in research participation. I used the listserv to recruit participants, a closed autism Facebook group, and word of mouth. I screened for demographics and eligibility for heterogeneity of the sample. Incentives were provided to encourage submission of the full ten minutes of video recording child-animal interactions.

Measures

Demographic form. The demographic form included child name, date of birth, ethnicity, diagnosis, co-occurring conditions, medications, household income, types of animals in the home, animal training, and amount of time child spends with the animal.

Social Responsiveness Scale (SRS; Constantino & Gruber, 2005). The SRS is a 65-item scale completed by parents or caregivers which measures the child's social abilities in natural settings. This scale is intended for children ages 4-18. The SRS has five components of social ability including social cognition, social communication, social motivation, social awareness, and autistic mannerisms. Lower scores are associated with lower levels of social deficits, while higher scores reflect more severe social impairments. The SRS has been validated in published research involving over 10,000 children and has shown to be reliable across raters over time (Constantino & Gruber, 2005). This measure is widely accepted and has been used extensively in research of families of children with ASD.

OHAIRE (Guerin et al., 2018). The OHAIRE coding tool is a timed interval behavior coding system which quantifies social communication and interactions with animals (O'Haire, McKenzie, Beck, & Slaughter, 2013). OHAIRE interactions include interactive behaviors (social communication and environmental interactions), emotional display (facial and verbal), and interfering behaviors (aggression, overactivity, and isolation). Social communication is the interaction between the participant and another person. Social communication is coded for

behaviors such as talk, gesture, look, touch, affection (e.g., cuddling, nuzzling, holding hands), and prosocial (purposefully helpful behavior). Environmental interactions are exchanges between the participant and the animal. Environmental interactive behaviors include talk, gesture, look, touch, affection, and prosocial. Researchers code emotional displays as verbal (positive, negative, and/or none) and facial emotion (positive, negative, and/or none). Examples of verbal emotional display include verbally expressing happiness, excitedness, joy, disdain, annoyance, irritation, and neutral content with no emotion. Examples of facial emotion include smiling, laughing, frowning, crying, and whining. Interfering behaviors include aggression (e.g., throwing, kicking, swearing), overactivity (e.g., rough play, talking rapidly), and isolation (e.g., silence, non-participation). Specific categories within the OHAIRE coding tool determine social interaction, which include talking, touching, gesturing, looking, being intentionally helpful, and showing affection. These interactions are coded as directed towards adults (18+), peers (similar age), and/or animals.

Every instance of social communication or interactive behaviors include a target defined as a person, animal, or object. One-zero sample method is utilized for OHAIRE coding. For every ten second interval, if the behavior is present in any part of the interval, the behavior is coded as present. The behavior is recorded as absent if the behavior is not exhibited throughout the ten second video. The frequency or duration of interactions within each interval are not coded. If individuals or animals are not visible in the video frame, the OHAIRE training manual specifies the interaction is not coded. I utilized ELAN (ELAN, 2019) software to cut the videos into ten second intervals per minute. I used Qualtrics (Qualtrics, 2020), an online survey software, to enter scores to code data with OHAIRE. My feasibility study showed some social interactions occurred outside the video frame and thus were not coded by OHAIRE. I
systematically tracked these interactions as they may be meaningful and unique to home-based settings.

The OHAIRE coding manual recommends video sessions be 10 minutes in duration for each participant (O'Haire et al., 2013; Martin & Farnium, 2002). The primary coder coded all video received from caregivers. The OHAIRE coding manual recommends a secondary rater code 20% of the videos to ensure inter-rater reliability, reaching a Cohen's kappa of \geq .80. The first data submitted by participants was sent to Purdue University, the creators of OHAIRE, to code for reliability.

Interview. Semi-structured interviews were used to gather information related to the

lived experiences of families who own animals. The questions were based on the quantitative

data gathered from the videos, as well as a scoping review (Lisk, Mische Lawson,

Vaduvathiriyan, 2020) of natural-based interventions of human-animal interaction for children

with ASD. Interview questions informed the research question: What are the lived experiences of

animal ownership in families of children with ASD?

Interview questions included:

- 1. Tell me about your animal or animals (*identify the animal*).
- 2. What are your family's reasons for owning an animal?
 - a. Why this type of animal, over another?
- 3. How would you describe your child's relationship with your animal?
- 4. Tell me about a typical day between your child and your animal?
 - a. How much time does your child spend with their animal?
 - b. Has this changed due to COVID?
- 5. What are the activities your child does specifically with your animal?
- 6. Are there safety considerations to owning an animal? If so, what are they?
- 7. Do you notice a difference in your child socially when your animal is present?
- 8. Are there challenges to owning an animal? If so, what are they?
 - a. Estimated cost?
 - b. Caregiver burden?
- 9. Do you think owning a pet is important for your child? Why or why not?
- 10. What factors about your child or family influenced your decision to have an animal in your home?

a. Do these factors influence your child's bond with the animal?

Coders

I was designated as the primary coder, and one researcher from Purdue University with extensive training on OHAIRE was considered the secondary coder. The OHAIRE manual instructs the primary coder to code the full set of videos and the secondary coder to code a minimum of 20% of the videos obtained for the study. Inter-rater reliability was interpreted using Cohen's kappa values ranging from no agreement to almost perfect agreement, where "values ≤ 0 indicate no agreement, .01 to .20 as none to slight; .20 to .40 as fair; .41 to .60 as moderate; .61 to .80 as substantial; and .81 to 1.00 as almost perfect agreement" (McHugh, 2012, p.278). A Purdue University researcher coded 24 minutes (21%) of the overall 114 minutes of video. Interrater reliability was established with almost perfect agreement, k = .858. The OHAIRE training manual provided syntax to run inter-rater reliability analyses.

Procedures

Following recruitment, consent forms were provided to caregivers via email, utilizing DocuSign. After consent, I asked caregivers to fill out the demographic form and the SRS. The demographic form and SRS were used to categorize participants and allowed researchers to categorize individuals based on autism severity and income. Caregivers were asked to provide ten minutes of video of naturally occurring interactions between their child and animals and submitted to researchers via secure file transfer. The purpose was to receive a depiction of the most natural interactions possible between the child and their animal. I provided written training for families on video etiquette, which reiterated the need to keep all participants (animal & child) in the frame, and to make all attempts to not interact with participants in the videos.

After interactions were recorded, I analyzed the video to determine any revisions to interview questions. I then scheduled times to meet with caregivers via secure telehealth platform for qualitative interviews. The interviews lasted between 20 - 60 minutes. The interviews were semi-structured in nature and recorded for later analysis. During the interview, I wrote field notes to record behavior, mannerisms, emotions, and interruptions (Creswell, 2009).

Analysis

Quantitative

I used descriptive statistics (e.g., frequencies, measures of central tendency and measures of variability) to summarize family income, gender, and age of child from the demographic form. I analyzed OHAIRE data to determine frequencies of specific pro-social behavior types, and the number of intervals per minute the participant engaged in such behaviors. This analysis included verbal, visual, and physical behaviors, and the target (e.g., caregiver, sibling, animal) of such behaviors. Further, I determined the frequency of emotional displays (e.g., laughing, smiling, frowning) and problem behaviors (e.g., yelling, physical aggression) exhibited throughout the data.

The OHAIRE calculates a human-animal bond (HAB) score to quantify the interactions taking place between the participant and the animal. This score ranges from 0-36, with six data segments that are scored per 60 second video. These data segments include talk, gesture, look, touch, affection, and purposefully helpful behavior. This score indicates social behaviors directed toward the animal throughout the video segment. I summarized demographic and SRS summary scores to describe characteristics of children in the sample (e.g., age, mild/severe autism, differing income levels) and calculated mean differences, standard deviations, and frequencies. I used Cohen's D effect sizes to compare differences in OHAIRE interaction scores based on child

characteristics (e.g., ASD severity, family income). I also explored differences in OHAIRE subscale scores including talk, gesture, look, touch, prosocial, and affection behaviors. Because age was a demographic characteristic of interest that could not be meaningfully grouped to explore differences, I calculated Pearson correlations to investigate relationships between age and total HAB scores and interaction scores. I included important social interactions occurring out of frame, and summarized the occurrences with descriptive statistics (e.g., frequencies of segments and percentage of total video) and narrative examples.

Qualitative

Qualitative analysis followed Braun and Clarke's (2012) six phase approach to thematic analysis. The six phases involved: 1) familiarizing with the data, 2) generating initial codes, 3) searching for themes, 4) reviewing themes, 5) defining and naming themes, and 6) producing a report. Thematic analysis is an inductive process which allows for the content of the data to develop the themes and codes and eliminates researcher bias or theoretical interests to drive the analysis. I was involved throughout the following six phases, alongside the primary research mentor. One health professions student assisted with coding, with supervision from the primary research mentor.

I transcribed interviews verbatim utilizing an online software (Temi, 2021) and read the transcripts to ensure accuracy and understand the content. The first phase involved absorbing the meaning and the depth of the data by actively reading the words of the transcripts, deriving meaning, and potential ideas for coding. Note taking, discussion, and generating ideas for coding occurred during this phase (Braun & Clarke, 2012). Phase 2 involved reading the transcripts to identify initial codes that synthesize the participant's meanings. I met with the primary research mentor and student to discuss my individual analyses to determine codes that would be used for

further coding processes. In order to establish interrater reliability, we coded 50% overlap data. Phase 3 involved sorting the codes received from analysis into themes. Our team collapsed some codes into bigger, overall themes. We revised themes after the first meeting to be more inclusive of the data elements and provided further synthesis to address similarities and differences between identified codes (Braun & Clarke, 2012). I met with the team and we generated themes and collapsed complex codes into simplified versions of the code meanings. Agreement was met between researchers regarding the consolidation of themes. Our focus in this stage was to tell an overall story of the concepts that participants conveyed within the interviews.

The fourth phase involved checking the quality of the created themes, and re-evaluating theme boundaries to include more codes, or to exclude existing ones. Braun and Clarke (2012) encourage collapsing themes together, splitting themes apart, or eliminating themes altogether with the goal to get the best representation of the data provided in the interviews. Once themes were decided upon, I re-read all the data to ensure the themes captured the overall meaning of the transcripts and verified validity of existing themes. The primary research mentor re-coded two transcripts to ensure theme validity. I member checked themes with two participants, as research encourages member checking with at least 10% of the sample (Braun & Clarke, 2012). We kept an audit trail to document all decisions made about the codes. Phase 5 involved determining how the themes were unique from one another and defining the interesting components of the supporting data within each theme. We ensured a singular focus of each theme and compared definitions between themes to come to agreement of theme definitions. Braun & Clarke (2012) describe the final phase as comprehensive throughout the process of data gathering, emphasizing the need to provide a compelling story of the data that is representative of interviews. I then wrote the data analysis to be thorough, transparent, and authentically represent rich evidence of

themes, utilizing quotations for emphasis (Creswell, 2009). I established validity through peer review, which included confirming codes and themes with the primary research mentor and one other member of the dissertation committee.

Quantitative and Qualitative Analysis

When analysis was completed for both quantitative and qualitative data sets, I combined the data sets and interpreted together. I was interested in learning how the qualitative information regarding parent experiences could help us understand the quantitative data from the Demographic form, Social Responsiveness Scale and OHAIRE coding outcomes. I examined how the social skills items within the OHAIRE, and the Social Responsiveness Scale aligned with the thematic analysis in the qualitative data set. I triangulated quantitative and qualitative results with existing literature to ensure validity.

Results

For this study, twelve participants enrolled, eleven caregivers consented, and ten provided data. The participant ages ranged from six to eleven years old. Eight participants were male, two were female, and all participants had a primary diagnosis of ASD. Eight participants had presence of a co-occurring condition including Attention Deficit Hyperactivity Disorder (ADHD), Sensory Processing Disorder, X Chromosome Abnormality, Developmental Coordination Disorder, and Global Developmental Delay. Two participants had a mild SRS severity score, four participants had a moderate SRS severity score, and three participants had a severe SRS severity score. Participants had family income ranging from \$40,001 - \$100,000+. Participants provided 114 total minutes of video for analysis. All ten caregivers utilized a cell phone to record video. Video was taken inside the home, as well as in the yard outside of the home. Table 1 displays a summary of participant demographic information.

Table 1

Participant Characteristics		Number	Percentage
Age			
C	6	2	20%
	7	1	10%
	9	3	30%
	10	2	20%
	11	2	20%
Sex		0	2024
	Male	8	80%
	Female	2	20%
Diagnosis	ASD*	10	100%
Co-occurring			
Conditions	ADHD**	2	20%
Conditions	Sensory Processing Disorder	$\frac{2}{2}$	20%
	Traumatic Brain Injury	1	10%
	X Chromosome Abnormality	1	10%
	Developmental Coordination	1	10%
	Disorder	1	1070
Race	Caucasian	7	70%
	Caucasian African American	, 1	10%
	Caucasian, Asian	2	20%
Income	Cuucusiun, Misiun	2	2070
meonie	\$40.001 - \$60.000	3	30%
	\$60,001 - \$80,000	2	20%
	\$80,001 - \$100,000	1	10%
	\$100,001 +	4	40%
# Household Members			
	3	3	30%
	4	6	60%
	5	1	10%
Animals in home	1 Dog	4	400/
		4	4U%
	1 Cat		10%
	3 Dogs, 1 Cat	2	20%
	3 Dogs	1	10%
	3 Dogs, 1 Fish	2	20%

Participant Demographic Information

Formal Animal			
Training	Yes	3	30%
	No	7	70%
Hours spent			
with pet per week	5	1	10%
	6	1	10%
	7	2	20%
	10	1	10%
	14	1	10%
	49	1	10%
	"As much as possible"	2	20%

* Autism Spectrum Disorder

** Attention Deficit Hyperactivity Disorder

Quantitative

I used descriptive statistics and frequencies to summarize age, gender, race, family income, and animal characteristics for each participant. I used frequencies to show SRS severity and HAB scores reflected in the data. I analyzed each of the pro social behavior types including talk, touch, look, affection, gesture, and prosocial directed toward the animal and calculated the number of 10-second interval's where the behavior was present. Analysis accounted for different amounts of video received from participants by removing any video greater than 10 minutes from analyses. No participant had less than 10 minutes of video. The scores below reflect the scores for an equal number of video sessions of 10 minutes. Interactive behaviors can range from 0 - 60 for the 10 minutes of video. Table 2 shows participant SRS scores, SRS severity, and animal interaction scores.

Table 2

Participant SRS and Animal Interaction Scores

Partic- ipant	SRS Score	SRS Severity	HAB [*] Score	Total Talk	Total Touch	Total Look	Total Affec- tion	Total Proso- cial	Total Gesture
1	65	Mild	214	27	60	59	32	1	35

2	66	Mild	54	0	25	21	2	3	3
3	107	Severe	180	9	56	43	51	0	21
4	62	Moderate	132	10	38	37	29	2	16
5	88	Moderate	146	1	59	41	34	0	11
6	88	Moderate	216	54	43	60	15	16	28
7	120	Severe	78	1	19	29	16	0	13
8	78	Moderate	245	41	54	58	34	16	42
9	89	Moderate	198	19	50	50	37	6	36
10	111	Severe	165	15	52	56	21	1	20

* Human Animal Bond

There is currently no standardized range for the HAB score, however the maximum possible HAB for each participant in this study is 360 and the minimum is 0. Mean SRS scores were 87.40 and mean HAB scores were 162.80. Further, I determined the frequency of facial and verbal emotional displays (e.g., speech content, laughing, smiling, frowning) and problem behaviors including overactivity and isolation exhibited throughout the data. Facial, verbal, overactivity, and isolation scores can range from 0 - 60 for the 10 minutes of video, which are represented in Table 3.

Table 3

Facial, Verbal, and Overactivity Interaction Scores

Participant	Positive Facial Emotional Display	Negative Facial Emotional Display	No Facial Emotional Display	Positive Verbal Emotional Display	Negative Verbal Emotional Display	Total Overact -ivity	Total Isolation
1	41	7	9	11	4	36	5
2	24	3	10	1	3	20	19

3	33	4	18	3	1	12	16
4	17	2	16	9	0	17	1
5	42	6	6	0	0	25	49
6	38	1	25	24	5	27	10
7	18	1	11	0	0	22	15
8	31	12	21	18	4	34	2
9	28	11	11	8	8	13	0
10	31	3	12	12	12	27	18

I explored differences in OHAIRE subscale scores including talk, gesture, look, touch, prosocial, and affection behaviors by ASD severity and income and calculated mean differences, standard deviations, and frequencies. I used Cohen's *d* effect sizes to compare differences in OHAIRE interaction scores based on ASD severity and income. There were meaningful differences with a large effect in overall interaction scores for children with moderate and severe ASD (d = .90). There were smaller effects for those with mild and moderate ASD (d = .62) and a negligible effect between those with mild and severe ASD (d = .07). Further, there were meaningful differences in talk, affection, and prosocial animal interaction scores by ASD severity.

Only one participant had income ranging from \$80,001 - \$100,000, so I combined this with income of individuals \$100,000+ for a category of \$80,001+. There were large effects for interaction scores for overall HAB scores, talk, gesture, look and touch between individuals with income \$60,001 - \$80,000 and those with \$80,001+. Table 4 shows the animal interaction scores by ASD severity and income with effect sizes. Full data can be found in Appendix A and B. Table 4

	ASD* Severity	Mean (SD)	Cohen's d
Total HAB			
Score	Mild	134.00 (113.14)	.62
	Moderate	187.40 (47.52)	
	N4:14	124.00(112.14)	07
	Milla	134.00 (113.14)	.07
	Severe	141.00 (55.07)	
	Moderate	187.40 (47.52)	.90
	Severe	141.00 (55.07)	
Talk	3.611.1	12 50 (10 00)	4.1
	Mild	13.50 (19.09)	.41
	Moderate	25.00 (21.98)	
	Mild	13.50 (19.09)	.35
	Severe	8.33 (7.02)	
		25.00 (21.00)	1.00
	Moderate	25.00 (21.98)	1.02
Gastura	Severe	8.33 (7.02)	
Oesture	Mild	19.00 (22.62)	
	Moderate	26.60 (13.07)	.45
	Mild	19.00 (22.62)	.06
	Severe	18.00 (4.35)	
	Moderate	26.60 (13.07)	
	Severe	18.00 (4.35)	.88
Touch			
	Mild	42.50 (24.75)	70
	Moderate	48.80 (8.41)	.19
	Mild	42 50 (24 75)	
	Severe	42.30(24.73) 42.33(20.31)	.01
	Severe	42.33 (20.31)	
	Moderate	48.80 (8.41)	42
	Severe	42.33 (20.31)	.72
Affection			1.09
	Mild	17.00 (21.21)	
	Moderate	29.80 (8.75)	
	5 61 1	17.00 (21.21)	.79
	Mild	17.00 (21.21)	
	Severe	29.33 (18.93)	

Meaningful Interaction Scores by Autism Severity and Income

			.03
	Moderate	29.80 (8.75)	
	Severe	29.33 (18.93)	
Prosocial	Mild	2.00(1.41)	70
	Moderate	8.00 (7.62)	./ >
	N/11		
	Milia Severe	2.00 (1.41)	1.55
	Severe	.33 (.58)	
	Moderate	8.00 (7.62)	1.42
	Severe	.33 (.58)	
Negative Facial			
Emotional	Mild	5.00 (2.82)	34
Display	Moderate	6.40 (5.03)	.54
	Mild	5.0 (2.82)	1.02
	Severe	2.67 (1.53)	1.03
	Moderate	6 40 (5 03)	
	Severe	2.67 (1.53)	1.00
No Facial			
Emotional	Mild	9.50 (.70)	117
Display	Moderate	15.80 (7.60)	1.17
	Mild	9.50 (.70)	1.50
	Severe	13.67 (3.79)	1.53
	Moderate	15.80 (7.60)	25
	Severe	13.67 (3.79)	.35
Positive Verbal			
Display	Mild	6.00 (7.07)	.70
	Moderate	11.80 (9.34)	
	Mild	6.00 (7.07)	.15
	Severe	5.00 (6.25)	
	Moderate	11.80 (9.34)	.85
	Severe	5.00 (6.25)	
	Income	Mean (SD)	Cohen's d
Total HAB			
Score	\$40,001-\$60,000	147.00 (61.99)	1.77
	\$60,001-\$80,000	229.50 (21.92)	
	\$40.001-\$60.000	147.00 (61.99)	.02
	\$80,001+	145.60 (60.65)	•• =
		` '	

	\$60,001-\$80,000	229.50 (21.92)	1.84
T 11	\$80,0001+	145.60 (60.65)	
Talk	\$40,001,\$60,000	11 67 (0 45)	2 31
	\$40,001-\$00,000 \$60,001-\$80,000	3/ 00 (9.43)	2.51
	\$00,001-\$80,000	34.00 (9.90)	
	\$40,001-\$60,000	11.67 (9.45)	.18
	\$80,001+	14.80 (22.38)	
	\$60,001-\$80,000	34.00 (9.90)	1.11
~	\$80,0001+	14.80 (22.38)	
Gesture	¢ 40 001 ¢ <0 000	22.00(11.70)	
	\$40,001-\$60,000	23.00 (11.79)	1.71
	\$60,001-\$80,000	38.50 (4.95)	
	\$40.001-\$60.000	23.00 (11.79)	
	\$80.001+	15.80 (9.52)	.67
	+ ,		
	\$60,001-\$80,000	38.50 (4.95)	2 00
	\$80,0001+	15.80 (9.52)	2.99
Look			
	\$40,001-\$60,000	45.00 (14.18)	1 34
	\$60,001-\$80,000	58.50 (.71)	1.57
	<u> </u>	45 00 (14 19)	
	\$40,001-\$00,000 \$20,001	45.00 (14.18)	.32
	\$80,001+	40.40 (13.90)	
	\$60.001-\$80.000	58.50 (.71)	1.00
	\$80,0001+	40.40 (13.96)	1.83
Touch	·		
	\$40,001-\$60,000	40.33 (18.50)	1.24
	\$60,001-\$80,000	57.00 (4.24)	1.24
	Φ 40 001 Φ <u>60</u> 000	40.22 (10.50)	
	\$40,001-\$60,000	40.33 (18.50)	.24
	\$80,001+	44.20 (13.85)	
	\$60.001-\$80.000	57.00 (4.24)	
	\$80.0001+	44.20 (13.85)	1.24
Affection	1 7		1.07
	\$40,001-\$60,000	24.67 (10.97)	
	\$60,001-\$80,000	33.00 (1.41)	
		. ,	.10
	\$40,001-\$60,000	24.67 (10.97)	
	\$80,001+	26.20 (18.67)	
			.51

\$60,001-\$80,000	33.00 (1.41)
\$80,0001+	26.20 (18.67)

Prosocial			
	\$40,001-\$60,000	2.33 (3.21)	.79
	\$60,001-\$80,000	8.50 (10.60)	
	\$40,001-\$60,000	2.33 (3.21)	36
	\$80,001+	4.20 (6.72)	
	\$60.001-\$80.000	8 50 (10 60)	48
	\$80,0001+	4.20 (6.72)	.40
Positive Facial	¢40.001.¢60.000	25 67 (6.91)	1 40
Display	\$60,001-\$80,000	36.00 (7.07)	1.49
	\$40.001-\$60.000	25.67 (6.81)	50
	\$80,001+	30.80 (10.23)	
	\$60.001-\$80.000	36.00 (7.07)	59
	\$80,0001+	30.80 (10.23)	10 /
Negative Facial	\$40,001-\$60,000	5.00 (5.20)	
Display	\$60,001-\$80,000	9.50 (3.53)	1.00
	\$40.001-\$60.000	5 00 (5 29)	
	\$80,001+	3.20 (1.92)	.45
	\$60,001-\$80,000	9 50 (3 53)	
	\$80,0001+	3.20 (1.92)	2.22
Positive Verbal	¢40.001.¢c0.000		1 4 1
Display	\$40,001-\$60,000 \$60,001-\$80,000	14.50 (4.95)	1.41
	¢40.001.¢60.000	6 67 (6 11)	00
	\$40,001-\$60,000 \$80,001+	7.40 (9.91)	.08
	¢<0.001.¢00.000	1450(405)	00
	\$60,001-\$80,000 \$80,0001+	14.50 (4.95) 7 40 (9 91)	.90
Negative Verbal	ψ00,0001	7.40 (9.91)	.62
Display	\$40,001-\$60,000	6.67 (6.11)	
	\$60,001-\$80,000	4.00 (.00)	1.07
			1.06

	\$40,001-\$60,000	6.67 (6.11)	
	\$80,001+	1.80 (2.17)	
			1.43
	\$60,001-\$80,000	4.00 (.00)	
	\$80,0001+	1.80 (2.17)	
Overactivity			
- · · · · · · · · · · · · · · · · · · ·	\$40,001-\$60,000	20.67 (7.09)	2.80
	\$60,001-\$80,000	35.00 (1.41)	
	\$40.001-\$60.000	20.67 (7.09)	.07
	\$80,001+	20.20 (6.06)	
	\$60,001-\$80,000	35.00 (1.41)	3.36
	\$80,0001+	20.20 (6.06)	
Vata Calan'a d	Small 0.2 Madium 0	5 Laura 0.9	

Note: Cohen's d Small = 0.2, Medium = 0.5, Large = 0.8

* Autism Spectrum Disorder

Due to the small sample size, I was unable to stratify the sample by age. Because age was a demographic characteristic of interest, instead of computing mean differences and effect size, I calculated two-tailed Pearson correlations to explore meaningful relationships between age and animal interactions. Pearson correlations revealed moderate, non-significant positive relationships between age and total HAB score (r = .468, α = .172), positive and negative facial totals (r = .504, α = .137; r = .586, α = .075), and gesture total (r = .504, α = .138). The strongest positive correlations were between age and touch total (r = .630, α = .051) and affection total (r = .660, α = .038), with the affection correlation being significant. Table 5 includes Pearson correlations based on age and animal interactions.

Table 5

Age and Interaction Score Correlations

Interaction	Pearson's r
Total HAB Score	.468*
Talk	002
Gesture	.504**
Look	.433*
Touch	.630**
Affection	.660**

Prosocial	225*
Positive Facial Display	.504**
Negative Facial Display	.586**
No Facial Display	362*
Positive Vocal Display	146
Negative Vocal Display	.203
Overactivity	.121
Isolation	.089

Note: Pearson's r, Low < .29, *Moderate < .49, **High > .50

The video included interactions that were unable to be coded by the current version of the OHAIRE coding tool. The tool restricts participants from interacting with individuals outside of the video frame, however there were instances where the child had meaningful conversations with the caregiver filming. This occurred in twelve (1.75%), ten second increments throughout the total 114 minutes of video provided by participants. Further, the child was actively playing with the animal in 25 (3.65%), ten second increments throughout the total video, and these interactions were unable to be coded effectively. Examples of play exhibited in the video included dancing, playing tug of war, tag, keep away, throwing the ball, wrestling, and charging like a dog. If the child was talking, looking, gesturing, or touching through these forms of play, those actions were coded, however the action of play was not captured.

Qualitative

Data analysis revealed three major themes within the participant interviews: child development, family considerations, and comfort. Table 5 reflects themes, definitions, and examples from the transcripts.

Child Development. Interviews with the families identified interactions with the animals teach the child responsibility by involving them in chores such as feeding, watering, and letting the animals outside to go to the bathroom. Nine families stated responsibility was a benefit of animal ownership. One family described the real-life experience of caring for the animal: "So... I

mean, there are days where he gets frustrated and not wanting to have to feed and water her, but feeding that's, that's his, his sole responsibility. Watering, him and his sister share it... But yes, he, I mean, for the most part that's he says that that is that she is his dog, so..." [11 year old male with mild ASD].

Further, four families reported the child shows assertion by training the animal and expressing their needs to the animal. For example, one family stated "he likes it when they lick his hand when he's stressed, so he trains him to do that." [10 year old male with moderate ASD]. Another family stated "she adores them, she wants to train them. When she was littler, I figured out she was feeding the dog when the dog behaved, and the 14-pound beagle went up to almost 20 pounds!" [6 year old female with moderate ASD]. One family used the training of the dog as a parallel to their relationship: "And so when people compliment him and compliment her [dog] behavior we've been able to use that as a really good reference point of... Oh, you noticed that the lady gave you a compliment cause your dog's behaving well, right? Your dog is a reflection of your good training, right? Well, when you behave well, it makes mom and dad look good. He goes, Oh, that makes a lot of sense." [9 year old male with severe ASD].

Nine families indicated the animals increase the child's empathy and understanding for the world outside of their family unit. One family explained "The other day, I guess they were playing and [cat] bit him, and I think it was more out of play because he's not an aggressive cat at all. And he's like, we need to get rid of this cat for any reason. And you know, cause we want him to understand it's a lifelong commitment to own a pet and so, you know, and I think he was just frustrated at the moment, but you know, he's, he would do anything for his cat." [10 year old male with severe ASD]. One child who scored severe SRS severity was described as learning how to interact with the animal to meet his preferences. "[Child] really likes, he really prefers

[dog] to be standing up and still, so [child] can... approach him slowly... he wants to like hold his tail and he wants to like see his back and see his ears. And... [child] prefers to approach [dog] from the back. But when you approach a dog from the back, they immediately turn around for attention. So they kind of do this like funny dance where they like circle around each other. But [child] has learned that the best time to approach [dog] from the back is while [dog] is eating." [9 year old male with severe ASD]. Another family stated "...it's nice to kind of increase his world just a little bit with additional, another creature who he can play with" [7 year old male with moderate ASD].

Four families described increased communication for the child while interacting with their animal. One family discussed their child was nonverbal prior to interactions with animals and noticed a significant difference when an animal joined their household. Another family described the child's communication preferences to be similar to talking to family members: "And he'll, you know, he'll talk to us just like he talks to the cat." [10 year old male with severe ASD]. Communication is also reflected in the quantitative coding video, coded as "talk."

Family Considerations. All ten families described animal characteristics such as size, breed, and temperament as important factors when considering animal additions to their family. No family indicated safety concerns for their animals or children. One family described their considerations "...but so that was a big factor is we were looking specifically for a poodle breed and [dog] is a golden doodle, a golden retriever poodle which is great. Like those are good family dogs. And we wanted like a mid-size to large dog who could kind of put up with bigger, like our kids were older already, so that those were our two considerations" [9 year old male with seve ASD]. Another family stated "We got them when they were both eight weeks old and from the humane society they were litter mates and they were the only two. And we just, we've known

from past experiences, when you get kittens, you need to get them in pairs and certainly couldn't leave one over the other." [10 year old male with severe ASD].

Informal training for the animal was seen as essential to trusting the animal and child relationship to seven of the ten families. One family described this need: "...and that's just food and the treats that she needs, you know, to continue, you know, specific training or just, you know, because she's a good dog, you know? So I've, I've had to work extra to kind of compensate for that. And then, and then the training, you know this is a breed that you just cannot go without some good training." [11 year old male with severe ASD, and 9 year old male with moderate ASD].

Seven families described cost of animal ownership and caregiver responsibilities as negative aspects of animal ownership, however each of these families indicated the cost to be justifiable for the relationship. "She gets her regular vet checks and shots and flea and tick prevention and she's been spayed and she gets licensed every year for rabies, you know? So that costs money.... but I think, I think all dogs, if you're going to have one, you know, take that care." [7 year old male with moderate ASD]. Time for caregiving was described by one family: "...for like a puppy or a dog that needs a lot of attention. We… work a lot and we're busy, so that would be hard." [11 year old male with severe ASD].

Comfort. All ten families indicated the animals provide stress and anxiety relief and added comfort to the child's life. One family explained by stating: "I know that they provide a safety net for her. Like if she gets stressed, she'll go...she can like sit with them. Like I have pictures of her sitting under her desk cuddling [dog] because when we were doing remote school, that was remote school was not okay for her. Not good...So that helped." [6 year old female with

moderate ASD]. "[Child] seeks them out for comfort more frequently or for fun." [10 year old male with moderate ASD].

Participant interviews also showed friendship and companionship as a reoccurring code that emerged from the data. Two families explained the child struggles with friendship and the animal was the child's only loyal friend. Another family stated: "Literally since day one, they are like the best of friends." [6 year old male with moderate ASD]. Companionship can also be seen from this family's experience: "I would find him sometimes, you know, if we're at lunch or on breaks or during the summer, I would find him at times where he had just gone and laid down on one of the beds, be it my bed or my oldest's bed or his own bed petting the cat. And he's falling asleep with him and, and you know, he'd be playing and the cat would be laying next to him and playing with him. So throughout the day, you know, you find them next to each other and doing whatever [child's] doing. And then at night when it's time for [child] to go to bed, usually [cat] already in his bed waiting for him to get in bed with him." [10 year old male with severe ASD].

Table 5

Theme	Definition	Examples
Animal ownership supports overall child development	Animal ownership supports child development, particularly in areas of responsibility, understanding situations and communication. Children learn responsibility through chores in the home including feeding, watering, walking, and letting the animal outside. Interactions with the animal improve child's empathy and understanding for the world including consequences in behaviors. Child communication	"His chore is to feed and water her. So that's first thing he does and she is right up next to him, following him as soon as he wakes up." 11 year old male with moderate ASD "It teaches him obviously responsibility and compassion and how to be gentle." 11 year old male with moderate ASD "He loves to feed him. He loves to do you know any sort of chores with him or give him bath" 7 year old male with moderate ASD

Qualitative Themes

	increases for the child when the animal is present.	"They're incredibly good about if the dogs are outside and they bark, they run and go get them and let them in because they don't want them cold or sad or whatever." 6 year old female and 10 year old male with moderate ASD "[Child] likes to lay with her, talk with herthey talk to each other" 11 year old male with moderate ASD "We noticed him how he acted around animals and he would look at us and tell us about them. And that's something he never did was look at us and tell us about somethingwhen [dog] came along I think it has really helped that." 9 year old female with moderate ASD
Animal ownership comes with important family considerations.	The type of animal and the size of the animal is an important consideration when choosing a family pet. Animal temperament is meaningful to the trust families have in child-animal interactions, and training helps to establish this trust. Cost and caregiving responsibilities are significant challenges of animal ownership.	"I mean, the problem with the small dog is they're more prone to being injured by the kids. So you have to manage that as well." 6 year old female and 10 year old male with moderate ASD "I don't think he likes a, a dog that's too excited That kind of scares him." 9 year old female with moderate ASD "She's part of our family, but she is a very high maintenance dog and she has had a lot of health issues, so going to the vet constantly. But other than that, I mean, in my opinion, that's just part of owning a pet." 11 year old male with mild ASD "We've learned with training these dogs they're just like humans. They need love, they need attention, they need affirmations. And if they don't get that over time, that builds up." 11 year old male with severe

		moderate ASD "I think we take having dog seriously, like he deserves walks and he deserves fresh air and like, that's a commitment that we're kind of willing to do right now, but it also makes us feel really guilty when we can't fulfill it." 9 year old male with severe ASD
Animal interactions provide comfort for the child.	Animal interactions relieve stress and anxiety for the child. The relationship the child has with the animal provides unconditional love, loyal friendship, companionship, and joy.	"both of them have a lot of anxiety and the dogs help with that." 9 year old male with severe ASD and 9 year old female with moderate ASD "Yeah, he definitely just views [dog] as like an interactive member of the family, and [dog] brings him a lot of joy." 9 year old male with severe ASD " whether they are on the floor together playing or just sitting next to each other they like literally are buddy, buddy next to each other." 11 year old male with mild ASD "I just think it gives him some companionship because he doesI mean, he doesn't have a lot of friends. I mean he has one, one good friend from school, but that's about it." 10 year old male with severe ASD "the unconditional love. Friendship's so hard for [child] and relating to people and the dogs specifically have created an unconditional forgiveness for her when she gets upset." 9 year old female with moderate ASD

ASD, and 9 year old male with

Quantitative and Qualitative Data

The qualitative theme comfort is also reflected namely in the codes of affection, but can also be seen in touch, talk, and emotional displays in the quantitative data. Examples of affection include showing physical affection or emotional warmth through things like cuddling, hugging, and petting. The qualitative theme of comfort substantiates this data, as families identified the companionship and anxiety relief as integral parts of their child's relationship with their animal. Further, prosocial scores were overall, very low for all children in this study. This can be related to the qualitative theme of child development in terms of teaching children responsibility. Prosocial behaviors are seen as purposefully helpful behaviors such as brushing, feeding, watering, or cleaning up after the animal. Though quantitative data showed prosocial behaviors were low in this population, caregivers reported their child(ren) with ASD demonstrated greater responsibility when the animal was present. Lastly, communication was an aspect of child development emerging in the qualitative data, which is also reflected in the code "talk." Participants with higher SRS scores (more severe ASD) were found to have lower talking scores.

Discussion

The primary aim of this study was to examine the heterogeneity of interactions between children with ASD and their animals in their homes. The secondary aim was to explore the lived experiences of animal ownership in families of children with ASD through qualitative interviews. Recruitment allowed for heterogeneity in ASD and income levels, however, did not allow for meaningful grouping in age. In a study analyzing participation of individuals with ASD, the authors found that recruitment for older adolescents to research studies can be difficult, as they are not a "captive population in the same way that children are" (Balfe & Digby, 2010, p. 2). Studies show families become less participatory in research as children age into adolescence and adulthood (Haas et al., 2016). Further, the average age of diagnosis in the United States is

three to six years (Autism Society, 2020), and during this stage, parents may be adjusting to a new diagnosis and less likely to participate in research. These factors may have led to my difficulty finding older adolescents and younger children to participate in this study.

Age and Development

Although my sample was limited to children ages 6-11, there were moderate correlations between age and look and total HAB scores. Age was most strongly associated with higher touch, gesture, and affection scores, suggesting children may develop better interaction with their animals as they age. Ward et al. (2017) found that as children age, they have increased responsibility for their animals than younger children, which encourages interaction and connection between the child and their animal. Responsibility and ownership were reflected in the qualitative data in my study, as many families reported an increase in responsibility and a sense of ownership for their child through animal interactions.

Further, both positive and negative facial totals were positively associated with age, which is supported in the research. In a study of 478 typically developing children, researchers found that as children aged, there were significant trends in children's ability to show and recognize other facial expressions (Lawrence, Campbell, & Skuse, 2015). Research shows children with ASD have less complex facial dynamics, and the expressions exhibited may not always represent the meaning and feeling an individual without ASD might show (Guha, et al., 2015). Interpreting these facial expressions in children with ASD should be used with caution, and suggestions for modifying the OHAIRE coding tool to identify these gaps may be beneficial for interpretation in this population.

Limited facial dynamics can hinder developing relationships, which can cause children with ASD to be isolated. All ten families identified comfort as an aspect of animal ownership,

which is also reflected in the quantitative codes such as look, touch, talk, and affection. In a scoping review, authors found that all but one study identified social skills and relationships as an outcome of animal ownership (Lisk, Mische Lawson, Vaduvathiriyan, 2020). The benefits included providing love and companionship, encouraging communication and social interaction, and improving the bonds within family relationships. Children with ASD struggle with peer friendships and engagement in social activities. In a study of children with ASD in classrooms with non-ASD children, children with ASD were less accepted, more isolated, and had significantly fewer reciprocal relationships than those without ASD (Rotheram-Fuller, Kasari, Chamberlain, & Locke, 2010). Caregivers in my study indicated the child's relationship with their animal was unconditional, reciprocal, and filled the gap for their severely limited friend group.

Learning empathy and emotional growth can further increase child development. In a study of typically developing children, 155 elementary students were interviewed about preferences, ownership, and attachment with their animals (Daly & Morton, 2006). The study found those children who scored high on the Lexington Attachment to Pets Scale, indicating greater levels of attachment, were more likely to be empathetic than those that were less attached. Another study examined parental perceptions of their children's experiences of animal ownership, which identified the child interpreting non-verbal behaviors of the animal and parents using the animals as an educational tool for understanding other social situations (Harwood, Kaczmarek, & Drake, 2018). Because symptoms of ASD include differences in social skills including communication, social interaction and social-emotional reciprocity (American Psychological Association, 2013), children and families experiencing these limitations may directly benefit from the human-animal bond. Animal ownership may assist children with ASD

increase their capacity for empathizing and learning, experiencing and understanding emotions, and recognizing the challenges and consequences of life. These skills may assist children with ASD develop later relationships with classmates and longer lasting friend groups.

Qualitative themes showed animal ownership supports child development, particularly in areas of responsibility, communication, and empathy and understanding for the world. Ward, Arola, Bohnert, & Lieb (2017) assessed 81 families with children with ASD and found that children who had more responsibility caring for their animal exhibited better social-emotional adjustment and better friendship quality than those that did not. In a recent article exploring types of responsibility capacities of children with ASD, researchers emphasize types of responsibility including role, causal, and outcome responsibilities which may increase autonomy and promote independent living for children with ASD (O'Brolchain & Gordijn, 2020). Families in my study indicated children were able to learn responsibility through chores in the home including feeding, watering, walking, and letting the animal outside. These skills can help increase the child's ability to be autonomous from their parents and live a more independent life.

ASD Severity and Income

There were also several meaningful differences related to ASD severity and income levels in children's animal interactions quantified by the OHAIRE tool. For example, children with severe ASD had the lowest and children with moderate ASD had the highest total HAB interaction scores. Autism severity was categorized with the Social Responsiveness Scale, so it is unsurprising children with severe ASD would have less social interaction with their pets. However, children with moderate ASD in this study had higher interaction scores than those with mild scores, warranting further examination of this finding. Additionally, talk, affection, prosocial, negative emotional display, no emotional display, and positive verbal display all showed large effect sizes with ASD severity. Carlisle (2014) surveyed 70 families of higher functioning children with ASD and found that those children show more assertion, which is explained by "initiating exchanges with another individual in a social setting" (p.1145). Further, research shows those with less severe ASD have higher responsibility for their animals (Ward et al., 2017), which is consistent with the findings in this study reflected by the prosocial interaction score. It is important to note that there was one outlier with mild ASD who had very low HAB scores and may have affected the outcomes of my study, notably in terms of ASD severity and income outcomes.

Total HAB score, talk, look, gesture, and touch showed large effect sizes between individuals with low and medium income, but showed negligible differences in those between the lowest and highest income ranges. Studies have shown some differences in social skill attainment due to income levels and resource availability, such as involvement in private schooling with smaller class sizes (Lauderdale-Litten, Howell & Blacher, 2013). Additionally, lower income has been linked to greater adverse life experiences and co-occurring mental health conditions, which can significantly affect a child's collective interactions and social skill attainment (Kerns, Newschaffer, Berkowitz, & Lee, 2017). However, in my study, there were negligible differences in the lowest and highest income categories, as well as potential outliers, so these factors warrant further exploration. Further, qualitative findings suggest cost is an aspect to consider for animal ownership. These results are validated in previous studies which found cost was associated with negative experiences for animal ownership (Burgoyne et al., 2014; Wright et al., 2016; Carlisle et al., 2018). The participants in my study, however, indicated that the financial cost was worth the gain in relationship with the animal. These results indicate areas

potentially sensitive to animal exposure, but due to the small convenience sample, conclusions cannot be drawn and applied to the general population.

Family Preferences

ASD severity and income may be a consideration for families seeking animal ownership, but a more significant factor may be individual/family preferences that affect the relationship between child and animal. Many families identified that they had previously owned animals and were accustomed to life with an animal, which may be more of an indicator of the relationship between child and animal than the level of ASD severity, income, age, or gender. A study of animal ownership preferences identified previous animal ownership by caregivers as a significant factor in ownership in families with children with ASD (Carlisle, 2014).

Family preferences was an important theme that emerged in the qualitative data. The type and size of animal were important for families to consider when inviting an animal to join their family. In a study of 90 families regarding animal ownership for children with ASD, researchers found the type of animal, size, and temperament was an important factor for the child due to notable sensory preferences (Carlisle, 2014). My study identified similar preferences, however there was no prescription for any family. Some preferred small (n=2), some large (n=4); however, eight families found training as an important factor regardless of size or breed. It is important to recognize, however, that some children with ASD do not prefer animals of any kind, and animal temperament or size would have little effect on this preference. Studies have reported families have had poor experiences with animals including aggression from the child or animal, including the death of a small animal (Carlisle, 2014; Harwood, Kaczmarek, & Drake, 2018).

Additionally, four families in my study identified caregiver responsibility for the animal was a negative aspect of animal ownership. Previous studies have identified this as a negative

aspect, and one study found this a reason for non-animal ownership for some families (Carlisle, 2014). Although age was associated with more responsibility of the animal, it is likely children with ASD provide less care for the animal than typically developing children, and therefore more burden on the caregivers whom are already experiencing higher levels of stress (Bonis, 2016).

OHAIRE

While the OHAIRE coding tool has been validated in ASD populations, it has primarily been used to capture human-animal interactions in a controlled environment. This study outlined instances where meaningful interactions were unable to be coded; suggestions for expanding the OHAIRE tool for in-home environments could lead to a better understanding of the child's experiences with their animals and quantify and explore areas of play between animals and children with ASD.

Limitations

While my study demonstrated rigor, limitations did exist. Due to volunteer bias and small sample size, the results cannot be generalized to the ASD population. It is also possible grouping within the small sample included outliers with very high or low HAB scores, influencing interpretation of results. Further, the caregivers were asked to film interactions and may have prompted their children to interact with their animal; therefore, the interactions filmed may not be the most realistic and representative of everyday interactions. Lastly, the OHAIRE tool showed some limitations in capturing play and activity outside of the camera during coding, which are meaningful interactions between the child and animal.

Implications

This study helps us understand the ways in which children interact with animals during unstructured time in their homes, which is critical to challenging existing paradigms of

intervention-based therapies. Intervention-based therapies can be costly and require trained providers, which may not be accessible to all families. Much of the current human-animal interaction literature encourages the use of animals as an intervention (Grandin et al., 2015; Pavlides, 2008), and does not explore the effects of families owning an animal. Exposure to animals in the home may be more accessible and provide similar benefits for families. Families may be advised to bring an animal into their home based on the promising results from intervention-based research. However, pet ownership comes with unique responsibilities and challenges. This study provides important insight into how children with ASD engage with animals and caregivers' perceptions of the benefits and challenges of pet ownership.

Due to the increased acknowledgement and awareness of animal-assisted therapies, federal and private organizations are supporting research devoted to this phenomenon. The Interagency Autism Coordinating Committee (IACC), which advises federal entities and stakeholders, has established goals related to advancements in autism research; among these goals include investigating treatments and interventions involving "psychosocial, developmental, and naturalistic interventions for the core symptoms and co-occurring conditions in ASD" (Interagency Autism Coordinating Committee, 2017, p. 60). Human-animal interactions in the home are naturalistic interventions and are considered a financial and research priority for the IACC. Future studies with larger sample sizes that aim to quantify human-animal interactions in children with ASD have promising support from private and federal funders of ASD research.

Conclusion

This study aimed to explore the experiences and natural interactions children with ASD have with their animals in their homes. It is the first mixed method study to utilize the OHAIRE coding tool in families' homes to understand human-child interactions with a diverse population

of children with ASD. This mixed methods study allowed us to learn from the families who already own animals, quantify social skills within human-animal interactions, and combine these data points to tell a full story of animal ownership in families of children with ASD. I also described child and family characteristics associated with favorable responses to having pets in the home so families can make informed decisions and professionals can provide educated guidance. Larger observational studies can help identify the effects income levels, age, and ASD severity may have on animal-child relationships. Future research should include larger sample sizes, observations of structured vs unstructured activities, and further analyze factors influencing animal ownership for families that own and do not own animals. Additional studies should involve adults with ASD to discover ownership preferences and behavior patterns in older populations.

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Chapter 5: Overall Conclusions

For many years, the research available in human-animal interactions was primarily dedicated to intervention-based therapies. Recently, there has been a growing interest in understanding the everyday interactions between us and our owned animals. This interest has spurred the creation of quantitative measures to help us begin to understand these interactions. The OHAIRE coding tool has been fundamental to adding to the quantitative literature and allowing us to understand these human-animal relationships between children with ASD and their animals. My three comprehensive exams provided critical groundwork for my dissertation study by allowing me to test and understand the OHAIRE coding tool for use in home-based settings.

My dissertation study discovered that there are a variety of factors for families with children with ASD to consider when choosing to have an animal in their home. Results from my study showed ASD severity and income are factors that are meaningful for families to consider and should be studied in further detail with larger sample sizes. Results from continued research will assist families to understand the risks and benefits of animal ownership, and help researchers be able to inform families of ways animals can improve the quality of life for their child with ASD.

	ASD Severity	Mean (SD)	Cohen's d
Total HAB	Mild	134 00 (113 14)	62
Score	Moderate	187 40 (47.52)	.02
	110 401400	10/110 (1/102)	
	Mild	134.00 (113.14)	.07
	Severe	141.00 (55.07)	
	Moderate	187.40 (47.52)	.90
	Severe	141.00 (55.07)	
Talk	N <i>1</i> :1.1	12 50 (10 00)	41
	Milla Moderate	13.50 (19.09)	.41
	widderate	23.00 (21.98)	
	Mild	13.50 (19.09)	.35
	Severe	8.33 (7.02)	
		、	
	Moderate	25.00 (21.98)	1.02
	Severe	8.33 (7.02)	
Gesture			
	Mild	19.00 (22.62)	.45
	Moderate	26.60 (13.07)	
	Mild	19.00 (22.62)	
	Severe	19.00(22.02) 18.00(4.35)	.06
		10.00 (1.00)	
	Moderate	26.60 (13.07)	0.0
	Severe	18.00 (4.35)	.88
Look			
	Mild	40.00 (26.87)	34
	Moderate	49.20 (10.13)	
	Mild	10 00 (26 97)	
	Millu Severe	40.00 (20.87) 12 67 (12 50)	.13
	SEVELE	42.07 (13.30)	
	Moderate	49.20 (10.13)	
	Severe	42.67 (13.50)	.55
Touch		、	
	Mild	42.50 (24.75)	.79
	Moderate	48.80 (8.41)	
	Mild	42.50 (24.75)	.01

Appendix A: Additional Table for ASD Severity and Interaction Scores

	Severe	42.33 (20.31)	
	Moderate Severe	48.80 (8.41) 42.33 (20.31)	.42
Affection	Mild Moderate	17.00 (21.21) 29.80 (8.75)	1.09
	Mild Severe	17.00 (21.21) 29.33 (18.93)	.79
	Moderate Severe	29.80 (8.75) 29.33 (18.93)	.03
Prosocial	Mild Moderate	2.00 (1.41) 8.00 (7.62)	.79
	Mild Severe	2.00 (1.41) .33 (.58)	1.55
	Moderate Severe	8.00 (7.62) .33 (.58)	1.42
Emotional Display	Mild Moderate	32.50 (12.02) 31.02 (9.67)	.14
	Mild Severe	32.50 (12.02) 27.33 (8.14)	.50
	Moderate Severe	31.02 (9.67) 27.33 (8.14)	.41
Negative Facial Emotional Display	Mild Moderate	5.00 (2.82) 6.40 (5.03)	.34
	Mild Severe	5.0 (2.82) 2.67 (1.53)	1.03
	Moderate Severe	6.40 (5.03) 2.67 (1.53)	1.00
Emotional Display	Mild Moderate	9.50 (.70) 15.80 (7.60)	1.17
	Mild Severe	9.50 (.70) 13.67 (3.79)	1.53

	Moderate Severe	15.80 (7.60) 13.67 (3.79)	.35
Positive Verbal			
Display	Mild	6.00 (7.07)	.70
	Moderate	11.80 (9.34)	
	Mild	6.00 (7.07)	.15
	Severe	5.00 (6.25)	
	Moderate	11.80 (9.34)	.85
NT / X7 1 1	Severe	5.00 (6.25)	
Negative Verbal Display	Mild	3.50 (.71)	.04
	Moderate	3.40 (3.43)	
	Mild	3.50 (.71)	.17
	Severe	4.33 (6.66)	
	Moderate	3.40 (3.43)	.18
0	Severe	4.33 (6.66)	
Overactivity	Mild	28.00 (11.31)	.48
	Moderate	23.20 (8.32)	
	Mild	28.00 (11.31)	.48
	Severe	20.33 (7.64)	
	Moderate	23 20 (8 32)	02
	Severe	20.33 (7.64)	.02

Note: Cohen's d Small = 0.2, Medium = 0.5, Large = 0.8

* Autism Spectrum Disorder

Figure 1: ASD Severity and Animal Interaction Scores

	Income	Mean (SD)	Cohen's d
Total HAB Score	\$40,001-\$60,000 \$60,001 \$80,000	147.00 (61.99) 229.50 (21.92)	1.77
	\$40,001-\$60,000 \$80,001-	147.00 (61.99) 145.60 (60.65)	.02
	\$60,001-\$80,000 \$80,0001+	229.50 (21.92) 145.60 (60.65)	1.84
T 11	φου,σουτη		
Talk	\$40,001-\$60,000 \$60,001-\$80,000	11.67 (9.45) 34.00 (9.90)	2.31
	\$40,001-\$60,000 \$80,001+	11.67 (9.45) 14.80 (22.38)	.18
	\$60,001-\$80,000 \$80,0001+	34.00 (9.90) 14.80 (22.38)	1.11
Gesture	\$40,001-\$60,000 \$60,001-\$80,000	23.00 (11.79) 38.50 (4.95)	1.71
	\$40,001-\$60,000 \$80,001+	23.00 (11.79) 15.80 (9.52)	.67
. .	\$60,001-\$80,000 \$80,0001+	38.50 (4.95) 15.80 (9.52)	2.99
Look	\$40,001-\$60,000 \$60,001-\$80,000	45.00 (14.18) 58.50 (.71)	1.34
	\$40,001-\$60,000 \$80,001+	45.00 (14.18) 40.40 (13.96)	.32
	\$60,001-\$80,000 \$80,0001+	58.50 (.71) 40.40 (13.96)	1.83
Touch	\$40,001-\$60,000 \$60,001-\$80,000	40.33 (18.50) 57.00 (4.24)	1.24
	\$40,001-\$60,000	40.33 (18.50)	.24

Appendix B: Additional Table for Income and Interaction Scores

	\$80,001+	44.20 (13.85)	
Affection	\$60,001-\$80,000 \$80,0001+	57.00 (4.24) 44.20 (13.85)	1.24
Affection	\$40,001-\$60,000 \$60,001-\$80,000	24.67 (10.97) 33.00 (1.41)	1.07
	\$40,001-\$60,000 \$80,001+	24.67 (10.97) 26.20 (18.67)	.10
	\$60,001-\$80,000 \$80,0001+	33.00 (1.41) 26.20 (18.67)	.51
Prosocial	\$40,001-\$60,000 \$60,001-\$80,000	2.33 (3.21) 8.50 (10.60)	.79
	\$40,001-\$60,000 \$80,001+	2.33 (3.21) 4.20 (6.72)	.36
	\$60,001-\$80,000 \$80,0001+	8.50 (10.60) 4.20 (6.72)	.48
Positive Facial Emotional Display	\$40,001-\$60,000 \$60,001-\$80,000	25.67 (6.81) 36.00 (7.07)	1.49
	\$40,001-\$60,000 \$80,001+	25.67 (6.81) 30.80 (10.23)	.59
	\$60,001-\$80,000 \$80,0001+	36.00 (7.07) 30.80 (10.23)	.59
Negative Facial Emotional Display	\$40,001-\$60,000 \$60,001-\$80,000	5.00 (5.29) 9.50 (3.53)	1.00
	\$40,001-\$60,000 \$80,001+	5.00 (5.29) 3.20 (1.92)	.45
	\$60,001-\$80,000 \$80,0001+	9.50 (3.53) 3.20 (1.92)	2.22
No Facial	¢40.001.¢20.000	11 22 (59)	61
Emotional Display	\$40,001-\$60,000 \$60,001-\$80,000	11.33 (.58) 15.00 (8.49)	.01

	\$40,001-\$60,000	11.33 (.58)	.70
	\$80,001+	15.00 (7.35)	
	\$60,001-\$80,000	15.00 (8.49)	.00
	\$80,0001+	15.00 (7.35)	
Positive Verbal		× /	
Display	\$40,001-\$60,000	6.67 (6.11)	1.41
	\$60,001-\$80,000	14.50 (4.95)	
	\$40,001-\$60,000	6.67 (6.11)	.08
	\$80,001+	7.40 (9.91)	
	\$60,001-\$80,000	14.50 (4.95)	.90
	\$80,0001+	7.40 (9.91)	
Negative			
Verbal Display	\$40,001-\$60,000	6.67 (6.11)	.62
	\$60,001-\$80,000	4.00 (.00)	
	\$40,001-\$60,000	6.67 (6.11)	1.06
	\$80,001+	1.80 (2.17)	
	\$60,001-\$80,000	4.00 (.00)	1.43
	\$80,0001+	1.80 (2.17)	
Overactivity			
•	\$40,001-\$60,000	20.67 (7.09)	2.80
	\$60,001-\$80,000	35.00 (1.41)	
	\$40,001-\$60,000	20.67 (7.09)	.07
	\$80,001+	20.20 (6.06)	
	\$60,001-\$80.000	35.00 (1.41)	3.36
	\$80,0001+	20.20 (6.06)	

Note: Cohen's d Small = 0.2, Medium = 0.5, Large = 0.8

Figure 2: Income and Animal Interaction Scores

Appendix C: Additional Output

Measures of Association

	Eta	Eta Squared
Talk_total * income	.480	.230
Gesture_total * income	.725	.526
Look_total * income	.533	.284
Touch_total * income	.440	.194
Affection_total * income	.230	.053
Prosocial_total * income	.359	.129
Positive_Facial * income	.434	.189
Negative_Facial_total * income	.636	.405
No_Facial_total * income	.298	.089
Positive_Vocal_total * income	.389	.152
Negative_Vocal_total * income	.569	.323
Overactivity_Total * income	.761	.579
HAB_Score * income	.572	.327

Figure 3: SPSS Output for Income & Interaction Scores with Eta

Measures of Association

	Eta	Eta Squared
Talk_total * SRS_Severity	.437	.191
Gesture_total * SRS_Severity	.347	.121
Look_total * SRS_Severity	.304	.093
Touch_total * SRS_Severity	.237	.056
Affection_total * SRS_Severity	.384	.148
Prosocial_total * SRS_Severity	.591	.349
Positive_Facial * SRS_Severity	.241	.058
Negative_Facial_total * SRS_Severity	.432	.187
No_Facial_total * SRS_Severity	.424	.180
Positive_Vocal_total * SRS_Severity	.422	.178
Negative_Vocal_total * SRS_Severity	.112	.013
Overactivity_Total * SRS_Severity	.345	.119
HAB_Score * SRS_Severity	.424	.180

Figure 4: SPSS Output for ASD & Interaction Scores with Eta

		HAB_Score	SRS_Total	income	SevereASD	ModerateAS D	MildASD
HAB_Score	Pearson Correlation	1	099	159	245	.422	247
	Sig. (2-tailed)		.786	.661	.496	.225	.492
	Ν	10	10	10	10	10	10
SRS_Total	Pearson Correlation	099	1	424	.860**	333	569
	Sig. (2-tailed)	.786		.222	.001	.348	.086
	Ν	10	10	10	10	10	10
income	Pearson Correlation	159	424	1	341	.223	.111
	Sig. (2-tailed)	.661	.222		.335	.536	.759
	Ν	10	10	10	10	10	10
SevereASD	Pearson Correlation	245	.860**	341	1	027	017
	Sig. (2-tailed)	.496	.001	.335		.744	.838
	Ν	10	10	10	146	146	146
ModerateASD	Pearson Correlation	.422	333	.223	027	1	022
	Sig. (2-tailed)	.225	.348	.536	.744		.790
	Ν	10	10	10	146	146	146
MildASD	Pearson Correlation	247	569	.111	017	022	1
	Sig. (2-tailed)	.492	.086	.759	.838	.790	
	N	10	10	10	146	146	146

Correlations

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 5: SPSS Correlation Output for ASD Severity and Incon	ne
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